VOL. XXXV. No. 3 JULY, 1952

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THE

MALAYAN AGRICULTURAL JOURNAL

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NOTES ON CURRENT INVESTIGATIONS, APRIL TO JUNE, 1952.

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DEPARTMENT OF AGRICULTURE, FEDERATION OF MALAYA.
Kuala Lumpur.
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THE

Malayan Agricultural Journal

Edited by the Publications Officer with the assistance of
The Publications Committee.

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THE

Malayan Agricultural Journal

JULY, 1952.

EDITORIAL

Padi Manurial Trials. The Department of Agriculture continues to give priority to investigations into methods of increasing the yield of padi in Malaya, and in this number of the Journal Mr. E. F. Allen, Senior Agronomist, reviews the results obtained in manurial trials carried out by the Department during the 1950-51 season.

Of the 107 trials carried out, 99 are described in Mr. Allen's article. The results of these trials, while producing no final conclusions were encouraging, and of great value in planning the 1951-52 season trials.

This review of the trials is rather late in appearing in print, the delay being largely dictated by the existing shortage of senior staff.

An Experiment in Mixed Farming. Mr. D. W. Le Mare, the Director of Fisheries, is welcomed to the pages of this Journal in giving an account of the first two years' progress of a venture by a group of Chinese businessmen in Penang to develop intensive farming with pigs, fish and vegetables, and eventually poultry and fruit as well.

Some of the success so far obtained in making this farm a paying proposition must be attributed to unusually favourable operating factors such as water supply and facilities for procuring feeding stuffs and transport. Nevertheless, results to-date do serve to indicate that Chinese smallholders, working on a co-operative basis, could run, at a profit, a farm on similar lines, given suitability of terrain and water supply, and provided food concentrates can be obtained at reasonable cost.

PADI MANURIAL TRIALS IN THE 1950-51 SEASON

BY

E. F. ALLEN,

Senior Agronomist.

Introduction.

One of the main points in the recent directive addressed to His Excellency the High Commissioner by the Secretary of State for the Colonies was that:

> "It is our duty to encourage and assist the Malays to play a full part in the economic life of the country, so that the present uneven economic balance may be redressed."

Since the production of padi in Malaya is virtually entirely in the hands of smallholders, the majority of them Malays, it is evident that any agricultural measure which will lead to increased padi yields per acre will also be of direct economic benefit to these smallholders. It is for this reason that agronomic research on the wet padi crop and, to a much lesser extent on dry padi also, has always accounted for a major portion of the Department's time and energy. Of recent years these investigations have been intensified and public interest requires that results be reviewed annually. A general account of some of the results has already been published (4) : it is now possible to give a more detailed account based on statistical analysis of experimental data.

Wet Padi Manurial Trials.

These investigations were in twelve series as follows:—

(1) North African versus Christmas Island rock phosphate.
(2) Rock phosphate placement trials.
(3) *Chelop* * trials.
(4) Bat guano and straw disposal trials.
(5) Nitrogen placement trials in the presence of phosphate.
(6) N.P.K. Placement Trial "E".
(7) Nursery manurial trials.
(8) Double cropping with manuring.
(9) Time of application of ammonium phosphate.
(10) Cultural and manurial trials.
(11) Varieties and manures.
(12) N.P.K. extension trials.

North African Versus Christmas Island Rock Phosphate.

This experiment, which was first laid down in 1949, was repeated in its second season in eight localities. The treatments were as follows:—

* *Chelop* = the dipping of the seedling into a slurry before planting in the field.

A. Control—no manure.
B. North African rock phosphate at 100 lbs. P_2O_5 per acre.
C. North African rock phosphate at 200 lbs. P_2O_5 per acre.
D. Christmas Island rock phosphate at 100 lbs. P_2O_5 per acre.
E. Christmas Island rock phosphate at 200 lbs. P_2O_5 per acre.

The fertiliser was applied to the crop from one to two weeks after transplanting, the irrigation water being drained off, where possible, before application.

Treatment yields from this series are summarised in Table I. Results from two experiments, which were complete or partial failures for climatic reasons, have been omitted from this table.

Table I.

Yield of Grain as Percentage of Control.

Experiment number.	Locality.	A Control.	B N.A. R.P. single	C N.A. R.P. double	D C.I. R.P. single	E C.I. R.P. double	M.S.D.* at 5 per cent.	Mean yield in lbs. per acre.
K.P.15	Telok Chengai	100	105	114	112	110	2.03	3,919
B.M.11	Bukit Merah	100	106	112	107	112	3.66	2,245
Pk.C.3/49	Talang	100	116	103	104	108	N.S.†	2,158
Pk.S.8/49	Sungei Manik	100	105	105	106	107	N.S.	1,571
M.14	Pulau Gadong	100	112	108	95	100	N.S.	2,162
Kn.30	Kota Bharu	100	101	102	103	99	N.S.	3,205

* M.S.D. = Minimum significant different.
† N.S. = Non-significant.

In four trials all treatment differences were insignificant but in Kedah (K.P.15) and Province Wellesley (B.M.11) all treatments gave a significant increase in yield as compared with control. In the latter trial it was also clear that there was no difference between the two types of rock phosphate but the double dressing of either gave a proportionate increase over the single dressing. The high yield from treatment D in trial K.P.15 is difficult to explain: it represents an increase in yield of 4.7 lbs. of padi for the application of 1 lb. of P_2O_5 or, at prices obtaining in April, 1952, an increment of 470 lbs. of padi, worth $69.00, for a fertiliser dressing which costs $15.40.

It would be unwise to argue too much from these results since there was no response in the first season of manuring. Furthermore, rock phosphate has proved to be an inefficient if cheap form of phosphatic fertiliser for padi in numerous other field experiments.

Rock Phosphate Placement Trials.

Three trials, with the following treatments, were repeated for a second season:—

MANURIAL TRIALS ON PADI STATIONS
IN THE FEDERATION OF MALAYA,
SEASON 1950 - 51
100°
102°
104°
6°
4°
2°
THAILAND
PERLIS
LANGKAWI IS.
HUTAN KAMPONG
TELOK CHENGAI
KEDAH
PROVINCE
WELLESLEY
PENANG
BUKIT MERAH
TG. PIANDANG
BRIAH
BAGAN SERAI
SELINSING
TALANG
PERAK
BRUAS
CHENDEROH
BALAI
SUNGEI MANIK
PASIR MAS
KOTA BHARU
BACHOK
MELOR
PASIR PUTEH
GERAI
KELANTAN
TRENGGANU
DONG
PAHANG
PAHANG TUA
SELANGOR
ULU KLAWANG
NEGRI SEMBILAN
AMPANG TINGGI
KENDONG
MALACCA
ALOR GAJAH
PULAU GADONG
JASIN
SUNGEI BALANG
JOHORE
SINGAPORE
X - PADI STATIONS

A. North African rock phosphate broadcast at 200 lbs. P_2O_5 per acre before transplanting.
B. Same application placed in a furrow between rows after transplanting.
C. Same application placed in a pocket near each plant after transplanting.
D. Control—no manure.

Treatment yields are summarised in Table II.

Table II.

Yield of Grain as Percentage of Control.

Experiment number.	Locality.	A Broadcast.	B Furrow.	C Pocket.	D Control.	M.S.D. at 5 per cent.	Mean yield in lbs. per acre.
Pk.N.7/49	Tg. Piandang	108	85	73	100	N.S. †	2,436
M.15	Pulau Gadong	124	117	111	100	14.28	1,973
Kn.31	Kota Bharu	102	98	98	100	N.S.	3,006

† N.S. = Non-significant.

Differences were not significant in the Kelantan and Perak trials; in Malacca (M.15) there was a significant response in yield from the broadcast and furrow dressings but not from the pocket application. This interesting difference shows that the placement of phosphate in pockets is a less efficient method than broadcasting, possibly because only a small proportion of the feeding roots were able to reach these pockets.

Three very similar experiments were carried out in Perak in co-operation with Messrs. Imperial Chemical Industries (Malaya) Ltd. The fertiliser dressing consisted of 2½ cwts. per acre of Christmas Island rock phosphate, equivalent to 106 lbs. P_2O_5 per acre. The treatments were:—

A. Phosphate broadcast immediately after transplanting.
B. Phosphate broadcast before cultivation.
C. Phosphate placed in the soil after transplanting.
D. Control—no fertiliser.

Treatment yields from these experiments are summarised in Table III.

Table III.

Yield of Grain as Percentage of Control.

Experiment number.	Locality.	A.	B.	C.	D.	S.E. *	Mean yield in lbs. per acre.
Pk.N.6/50	Selinsing	94	82	96	100	5.19	1,095
Pk.N.10/50	Briah	104	90	87	100	5.41	1,036
Pk.C.5/50	Talang	106	110	87	100	5.83	1,123

* S.E. = Standard Error.

All differences were insignificant, so it may be concluded that a dressing of rock phosphate at 106 lbs. P_2O_5 per acre gave no response in the first season after application.

Chelop Trials.

The time-honoured Malay fertiliser practice known as *pekerjaan menchelop* consists of dipping the roots of padi seedlings, before transplanting, into a slurry prepared by mixing together wet clay with either bat guano or calcined bones. The majority of Malayan bat guanos used for this purpose contain very little nitrogen but the phosphoric acid content varies from 3 to 20 per cent. or occasionally more.

The following trials, which are of somewhat local interest, were carried out:—

Malacca Treatments (M.7, 8 and 9)

A. No manure.
B. *Chelop* with calcined bones.
C. *Chelop* with cowdung.

Kedah Treatments (K.P.30)

A. *Chelop* with North African rock phosphate at the equivalent of 27 lbs. P_2O_5 per acre.
B. *Chelop* with North African rock phosphate at the equivalent of 13½ lbs. P_2O_5 per acre.
C. *Chelop* with Christmas Island rock phosphate at the equivalent of 27 lbs. P_2O_5 per acre.
D. *Chelop* with Christmas Island rock phosphate at the equivalent of 13½ lbs. P_2O_5 per acre.
E. Control—no manure.

Perak Treatments (Pk.S.10/50)

A. Control—no manure.
B. Field application of rock phosphate at 200 lbs. P_2O_5 per acre.
C. *Chelop* with bone meal.
D. Field application of bat guano at 100 lbs. P_2O_5 per acre.
E. Field application of rock phosphate at 100 lbs. P_2O_5 per acre.

Yields of grain from these experiments are given in Table IV.

All differences were quite insignificant and it is evident that the treatments had no effect on yield. It has, therefore, been decided to conclude Federal investigations on *menchelop* and to study more precise methods of fertilising young padi seedlings with phosphatic fertiliser.

Table IV.

Yield of Grain as Percentage of Control.

Experiment number.	Locality.	A N.A. R.P. double.	B N.A. R.P. single.	C C.I. R.P. double.	D C.I. R.P. single.	E Control.	S.E.	Mean yield in lbs. per acre.
K.P.30	Hutan Kampong	101	112	112	108	100	6.08	1,845

Experiment number.	Locality.	A Control.	B Rock phosphate single.	C *Chelop.*	D Bat guano single.	E Rock phosphate single.	S.E.	Mean yield in lbs. per acre.
Pk.S.10/50	Sg. Manik	100	98	92	94	96	4.17	2,182

Experiment number.	Locality.	A No manure.	B *Chelop* with bone.	C *Chelop* with dung	S.E.	Mean yield in lbs. per acre.
M.7	Pulau Gadong	100	104	96	4.10	1,890
M.8	Jasin	100	118	96	8.5	1,316
M.9	Alor Gajah	100	114	131	29.4	506

Bat Guano and Straw Disposal Trials.

In Kedah and, to a lesser extent, in Province Wellesley, it is a common practice for smallholders to apply heavy dressings of bat guano to padi fields at regular intervals. Both rate of application and phosphoric acid content vary over wide limits but an average dressing per acre in north Kedah would be 1,500 lbs. of guano containing 10 per cent. P_2O_5 applied once in three years. This is equivalent to an annual application of 50 lbs. per acre P_2O_5.

Two experiments were continued in the 1950-51 season to study the effect of bat guano applications. Treatments were as follows:—

Main Treatments

A. Application every year.
B. „ „ 2 years.
C. „ „ 3 „
D. „ „ 4 „
E. „ „ 5 „
(First application of all treatments in 1947).

Sub Treatments

a. Total application in 15 years of 3,000 lbs. per acre.
b. „ „ „ „ 4,500 „ „
c. „ „ „ „ 6,000 „ „
d. „ „ „ „ 7,500 „ „
e. „ „ „ „ 9,000 „ „
o. „ „ „ „ Nil „ „

These treatments apply to the Province Wellesley experiment, B.M.5, but treatment E and the dressing of 3,000 lbs. were both omitted in north Kedah (K.P.2). Yields of grain are summarised in Table V.

Table V.

Yield of Grain as Percentage of Control.

Experiment number.	Locality.	Every year.	Every 2 years.	Every 3 years.	Every 4 years.	Every 5 years.	M.S.D. at 5 per cent.	* Mean yield in lbs. per acre.
K.P.2	Telok Chengai	100	99	100	99	—	N.S.	3,887
B.M.5	Bukit Merah	100	91	109	98	103	8.6	1,643

Experiment number.	Locality.	3,000 lbs.	4,500 lbs.	6,000 lbs.	7,500 lbs.	9,000 lbs.	Nil.	M.S.D. at 5 per cent.	* Mean yield in lbs. per acre.
K.P.2	Telok Chengai	—	105	107	107	107	100	4.5	3,840
B.M.5	Bukit Merah	112	115	121	124	130	100	5.5	1,597

* N.B. This figure has been calculated only from sub-plots receiving manure.

It will be seen from the sub-treatment yields that there was a significant response to fertiliser at each locality and that the larger dressings gave increased increments in trial B.M.5 but not in K.P.2. Differences between treatment yields were significant only in trial B.M.5, but it should be remembered that the very nature of these treatments prevents useful information from being extracted from one year's results.

The information yielded by these large experiments is somewhat disappointing and trial K.P.2 has now been concluded. Trial B.M.5 is being continued for one more season only, in order to complete the first five-year cycle.

A very interesting long-term investigation on the effect of different methods of straw disposal combined with a regular application of bat guano was carried out in north Kedah during the twelve-year period 1936 to 1948. Since the full results from this investigation have not yet been published it will be convenient to summarise them here.

The treatments were as follows:—

A. Padi straw and stubble removed.
B. Straw and stubble burnt *in situ.*
C. Straw spread over surface.
D. Straw and stubble burnt *in situ* and about 1,500 lbs. per acre of bat guano applied once in three years.

Results for the first three seasons were lost during the war but those for the other nine seasons have been analysed both separately and as a series. These are summarised in Table VI.

Table VI.
Yield of Grain as Percentage of Mean.
Experiment K.P.1—Telok Chengai.

Season.	Straw removed.	Straw spread.	Straw burnt.	Straw burnt and guano applied.	S.E.	M.S.D. at 5 per cent.	Mean yield in lbs. per acre.
1939-40	90	93	103	113	2.04	7.1	2,728
1940-41	103	86	103	108	4.60	N.S.	3,620
1941-42	82	107	97	113	2.02	7.0	2,610
1942-43	92	102	93	114	1.85	6.4	3,063
1943-44	96	106	98	100	5.58	N.S.	1,727
1944-45	99	106	93	102	2.97	N.S.	2,337
1945-46	97	106	98	100	4.74	N.S.	1,609
1946-47	98	92	107	103	4.87	N.S.	962
1947-48	102	102	99	97	2.33	N.S.	2,064
1939-48	95	99	99	107	2.96	10.2	2,302

It is clear that the treatment effects varied widely with season but that, with the exception of the 1940-41 season, differences were significant in favourable years. Actually, in the exception noted when the error was high, differences were significant at about 7 per cent. Low yields in the 1943-44 and 1945-48 seasons were the result of late planting with old seedlings, due either to the misfortunes of war or to abnormally dry weather.

Statistical analysis of the overall results is complicated by the fact that the experiment was repeated year by year on the same site. Hence the random effect of years on treatments is confused with the systematic residual effects of treatments on years. The standard error quoted in Table VI is based on a conservative estimate of the interaction of years on treatments.

The following conclusions may be drawn from these results:—

1. There has been a definite response in yield from bat guano in three out of nine seasons but the overall response is non-

significant, largely owing to use of old seedlings and late planting due to external events in the four seasons 1943-44 and 1945-48.

2. The apparent reduction in yield due to removal of straw and stubble was non-significant.
3. There has been no difference in effect when the straw is either *in situ* or spread on the land.
4. The average increment due to the application of bat guano was approximately 186 lbs. per acre or about 32 gantangs per acre per year.
5. At post-war prices the application of bat guano would have cost a smallholder from $26.45 to $34.65 or an average of $10.18 per acre per year. At present Kedah padi prices ($19.00 per picul = 133.3 lbs.) the mean increment would be worth $26.51 per acre. The application of bat guano is, therefore, economic provided that this somewhat bulky fertiliser does not have to bear high freight charges.

Nitrogen Placement Trials in the Presence of Phosphate.

Under this heading there were two series of investigations carried out in Perak and Province Wellesley in co-operation with Messrs. Imperial Chemical Industries (Malaya) Ltd. Treatments in the first series are shown diagramatically as follows:—

Time of Application	A	B	C	D	E	F	G	H
Immediately after transplanting	P	P	P	P	P	—	P	—
„ „ „	N	—	—	—	N|4	N|4	—	—
1 month „ „	—	N	—	—	N|4	N|4	—	—
2 months „ „	—	—	N	—	N|4	N|4	—	—
3 „ „ „	—	—	—	N	N|4	N|4	—	—

Rates of application of the two nutrients were:—

53 lbs. nitrogen per acre as sulphate of ammonia.

106 lbs. P_2O_5 per acre as Christmas Island rock phosphate.

These fertilisers were mixed with sand and handfuls placed about four inches deep in the soil between every four clumps of padi.

Yields of grain from these experiments are summarised in Table VII.

Table VII.

Yield of Grain as Percentage of Control.

Experiment number.	Locality.	A.	B.	C.	D.	E.	F.	G.	H.	M.S.D. at 5 per cent.	Mean yield in lbs. per acre.
Pk.N. 7/50	Selinsing	100	97	97	100	105	85	94	100	N.S.	1,049
Pk.N. 9/50	Bg. Serai	103	109	115	111	114	88	110	100	14.7	1,129
Pk.N.11/50	Briah	80	99	100	94	103	104	107	100	14.3	1,063
Pk.C. 6/50	Talang	130	136	104	98	144	120	94	100	26.5	1,468

In trial Pk.C.6/50, yields from treatments E and B were superior to those from C, H, D and G, and A was superior to H, D and G. It may be concluded, therefore, that nitrogen applied early or in small doses and in the presence of phosphate gave a response but that rock phosphate alone was not beneficial.

In trial Pk.N.9/50, all treatments except H were significantly superior to F, and C was superior to H. There was thus a clear response in yield from phosphate but none from nitrogen.

In the last trial, Pk.N.11/50, all treatments except D were superior to A, so it would seem that, at this locality, a heavy dressing of nitrogen at planting was harmful.

Treatments in the second co-operative investigation were as follows:—

A. Phosphate plus sulphate of ammonia.
B. Phosphate plus nitrate of soda.
C. Phosphate plus urea.
D. Phosphate alone.
E. Control—no manure.

Rates of application were as follows:—

280 lbs. per acre Christmas Island rock phosphate—106 lbs. P_2O_5.
476 „ „ „ sulphate of ammonia — 100 lbs. nitrogen.
560 „ „ „ nitrate of soda — 90 „ „
218 „ „ „ urea — 100 „ „

It is not known why the application of nitrate of soda was not equivalent to 100 lbs. of nitrogen but the difference was probably due to an error in calculation.

All fertilisers were placed in the soil, by hand, one month after transplanting; the method of application being the same as in the other series.

Yields of grain from these experiments are summarised in Table VIII.

Table VIII.

Yield of Grain as Percentage of Control.

Experiment number.	Locality.	A.	B.	C.	D.	E.	M.S.D. at 5 per cent.	Mean yield In lbs. per acre.
—	Ch. To'Kun	111	104	115	94	100	11.7	2,923
—	B. Maung	101	117	123	109	100	10.6	1,655
Pk.N. 8/50	Selinsing	100	121	113	107	100	10.5	1,171
Pk.N.12/50	Briah	87	104	103	93	100	N.S.	960
Pk.C. 7/50	Talang	114	124	111	99	100	N.S.	1,523

Differences were not significant in trials Pk.C.7/50 and Pk.N.12|50. In the other three trials there was a significant response in all from urea, in two from nitrate of soda and one from sulphate of ammonia.

The failure of sulphate of ammonia to give a response in two trials is difficult to explain. This is being investigated further in the 1951-52 season.

Placement Trial.

This trial was designed to investigate the effect of the application of twelve different fertilisers in packet form when placed below individual clumps of padi six weeks after transplanting. Micro-plots were used and the different treatments were as follows:—

Treatment.	Fertiliser.	gms. per plant.	lbs. per acre.	N. lbs. per acre.	P_2O_5 lbs. per acre.	K_2O lbs. per acre.
1.	Ammonium sulphate	3	288	60	—	—
2.	Ammonium nitrate	4	384	134	—	—
3.	Ammonium carbonate	2.5	240	58	—	—
4.	Mono-ammonium phosphate	3	288	35	176	—
5.	Ammonium chloride	2.5	240	62	—	—
6.	Rock phosphate	9	864	—	320	—
7.	Double super-phosphate (40%)	9	864	—	346	—
8.	Potassium chloride	4	384	—	—	230
9.	Ammonium sulphate	3	288	60	—	—
	Rock phosphate	9	864	—	320	—
10.	Ammonium sulphate	3	288	60	—	—
	Double super-phosphate	9	864	—	346	—
11.	Calcium cyanamide	3	288	60	—	—
12.	Ammonium sulphate	3	288	60	—	—
	Double super-phosphate	9	864	—	346	—
		4	384	—	—	230
13.	Control	—	—	—	—	—

These treatments can be criticised on the grounds that they are not all comparable. However, in the case of Treatment 2 it was thought that placement of ammonium nitrate in the soil might result in reduction of the nitrate ion so that only the ammonium nitrogen in this salt would become available to the growing crop.

This trial was laid down in 31 localities, but three experiments were failures because of flood and pest damage and three experiments failed for other reasons. Results from the balance of 25 trials are summarised in Tables IX and X.

Table IX.

Placement Trial—Yield of Grain as Percentage of Control. West Coast and Central Bendangs.

Treatment.	K.P. 31 TC.	K.P.31 HK.	B.M.14.	Pk.N. 2/50.	Pk.N. 3/50.	Pk.C. 2/50.	Pk.C. 4/50.	Pk.S. 4/50.	Pk.S. 5/50.	W.Pbg.5	N.S.7.	N.S.8.	N.S.9.	M.26.	J.P.T. 17/50.
Locality.	Telok Chengai.	Hutan Kg.	Bukit Merah.	Bg. Serai	Selinsing	Talang.	Bruas.	Sg. Manik.	Ch. Balai.	Dong.	Kendong	Ulu Klawang	Ampang Tinggi.	Pulau Gadong.	Sungei Balang.
1	123	97	146	88	91	121	58	95	87	156	183	102	136	83	63
2	115	135	168	104	91	158	73	70	113	100	124	80	78	93	188
3	120	136	150	96	118	108	138	84	87	139	138	83	88	91	250
4	135	209	167	163	227	133	96	84	70	93	87	76	109	103	438
5	125	128	167	92	164	125	65	84	78	139	81	91	120	60	156
6	108	102	100	108	118	96	65	89	92	100	104	83	71	89	219
7	103	118	98	108	164	88	135	87	78	115	125	91	99	102	63
8	115	111	117	104	164	121	119	78	113	107	164	97	93	92	44
9	124	120	139	75	127	108	77	76	87	139	93	104	111	94	250
10	130	148	154	150	155	175	77	73	78	188	113	107	138	78	156
11	106	105	130	96	200	117	69	92	100	95	123	98	118	105	250
12	128	153	172	121	227	154	127	81	109	198	140	121	134	129	375
13	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
M.S.D. at 5 per cent.	20.6	19.8	24.1	26.2	61.6	35.5	29.2	N.S.	N.S.	46.3	N.S.	N.S.	37.4	N.S.	N.S.
Mean yield in lbs per acre	4,146	2,077	3,451	2,823	1,793	3,225	2,614	3,384	2,295	3,581	534	2,018	1,304	231	598
Soil	Heavy clay.	Sandy clay.	Alluvial clay.	Medium clay.	Medium clay.	Clay.	Sandy clay.	Heavy clay.	Peat.	Light clay.	Medium clay.	Medium clay.	Medium clay.	Medium clay.	Organic clay.

Table X.

Placement Trial—Yield of Grain as Percentage of Control. East Coast Localities.

Experiment number.	Kn.46 (a).	Kn.46 (b).	Kn.46 (c).	Kn.46 (d).	Kn.46 (e).	Kn.46 (f).	Kn.46 (g).	Kn.46 (h).	Kn.46 (j).	Tr.2.
Locality.	Kota Bharu.	Bachok.	Pasir Puteh.	Pasir Mas.	Pangkal Kalong.	Perupok, Bachok.	B. Abal, P. Puteh.	Gual Periok, P. Mas.	Panyit, Ulu Kelantan.	Gerai.
1. Ammonium sulphate	143	141	100	214	28	177	65	111	76	52
2. Ammonium nitrate	126	146	177	209	257	221	59	82	92	49
3. Ammonium carbonate	94	141	121	209	86	211	94	108	73	58
4. Ammonium phosphate	132	183	657	286	1,872	166	350	77	92	381
5. Ammonium chloride	118	162	140	146	86	200	53	74	60	55
6. C.I. Rock phosphate	91	116	132	153	115	177	107	111	88	88
7. Double superphosphate	97	104	467	171	621	232	142	89	124	235
8. Potassium chloride	91	104	177	122	264	177	71	79	52	91
9. Ammonium sulphate + Rock phosphate	117	162	134	180	236	200	107	61	76	55
10. Ammonium sulphate + superphosphate	151	199	568	310	1,243	389	308	74	148	349
11. Calcium cyanamide	120	129	121	155	64	211	83	102	69	52
12. Ammonium sulphate + rock phosphate + potassium chloride	166	241	657	289	2,544	434	299	87	165	490
13. Control	100	100	100	100	100	100	100	100	100	100
M.S.D. at 5 per cent.	73.6	36.8	219	61.5	358	111	121	N.S.	35.1	50.8
Mean yield in lbs. per acre	2,825	2,422	1,666	2,021	882	1,359	1,616	956	1,579	1,666
Soil type	Medium clay loam.	Coastal sand.	Sandy clay.	Medium clay loam.	Very sandy clay.	Poor sandy clay.	Poor sandy clay.	Sandy clay.	Clay loam.	Clay.

Series means from all trials showing statistical significance are summarised in Table XI.

Table XI.

Placement Trial "E"—Series Means from Trials showing Statistical Significance.

	Treatment.	East Coast Series.	West and Central Series.
1.	Ammonium sulphate	111	113
2.	Ammonium nitrate	148	114
3.	Ammonium carbonate	121	121
4.	Ammonium phosphate	458	148
5.	Ammonium chloride	113	125
6.	Rock phosphate	119	96
7.	Double superphosphate	244	114
8.	Potassium chloride	128	117
9.	Ammonium sulphate + rock phosphate	141	113
10.	Ammonium sulphate + double superphosphate	407	146
11.	Calcium cyanamide	112	115
12.	Ammonium sulphate + double superphosphate + potassium chloride	587	157
13.	Control — no fertiliser	100	100

The following conclusions may be made from this investigation:—

1. The chief nutrient requirement on the East Coast is soluble phosphate.
2. Rock phosphate is an unsuitable fertiliser for padi throughout Malaya.
3. Nitrogen in the presence of soluble phosphate gives a large additional increase in yield on the East Coast and also, to a lesser extent, on the West Coast.
4. Potash gives a marked response on the East Coast, this effect being accentuated in the presence of nitrogen and soluble phosphate.
5. Mono-ammonium phosphate is relatively more efficient in increasing yields on the East Coast than a mixture of sulphate of ammonia and superphosphate. This trend was also noted on the West Coast but was somewhat less marked.
6. The need for a balanced fertiliser mixture is outstanding on the sandy soils of the East Coast.
7. Anomalous results noted from certain individual experiments may perhaps be explained by the occurrence of nutrient drift as the plot size was only 20 square feet with inter-plot discards of two feet.

Since it would obviously be unwise to base a manurial extension programme on the results obtained from micro-plot trials, this investiga-

tion has not been continued. However, the results have been used in the planning of a new series of long-term investigations.

Nursery Manurial Trials.

A simple trial was laid down in 1950 to test whether an increase in yield would result from the use of seedlings which had been manured in the nursery. Actual treatments were as follows:—

A. Nursery manured before sowing with 2 ozs. "Supram" per square yard.

B. Nursery not manured.

"Supram" is a proprietary fertiliser mixture with an N.P.K. analysis of 10.5 : 7.5 : 5.4 per cent. containing the following fertilisers:—

Sulphate of ammonia	....	49 parts by weight.
Superphosphate 18 per cent.	42	„ „ „
Muriate of Potash 60 per cent.	9	„ „ „

This was laid down at 20 localities with, usually, only two replications. Since each single experiment was, with one exception, inadequately replicated the whole series of yields have been analysed as one experiment. Yields from this series are summarised in Table XII.

Table XII.

Yield of Grain.

Nursery Manurial Series.	Nursery manured.	Nursery not manured.	S.E.
Yields as percentage of Control	102	100	1.43
Yields in lbs. per acre	2,138	2,094	30.0

In most localities where growing conditions were good, it was noted that the manured seedlings were a deeper green in colour and sometimes also more vigorous. However, these differences tended to disappear soon after transplanting and tiller counts indicated that the benefits of the manure were ephemeral. The small yield difference did not attain statistical significance.

It is sound agricultural practice with almost all annual crops to give seedlings a good start, and the negative result obtained from this investigation will not discourage further experiments with nursery manuring.

In retrospect it is now clear that the manurial treatment given can be criticized on the following points:—

(a) Since nursery practice varies widely throughout Malaya the manurial application should have been defined in terms of units of seed padi and not in units of nursery area.

(b) The fertiliser mixture used probably had too high a nitrogen-phosphate ratio,

(c) For the *rakit* or floating nursery the fertiliser application was extremely low as it corresponded to 4 ozs. "Supram" per gallon of padi seed or 12 ozs. per planted acre.

(d) It has been suggested that, to obtain the maximum benefit from nursery manuring, the manured nurseries should be larger, per unit of seed, to allow for more vigorous seedling growth.

(e) It is standard market garden practice to manure nurseries with very heavy dressings of organic fertilisers and it is possible that an organic-inorganic mixture would be more beneficial than a purely inorganic one. Phosphate is known to be the chief nutrient requirement of young padi seedlings and it has been suggested (5) that this nutrient may remain available to plants for a longer period when applied with organic matter than when applied alone.

Double Cropping and Manuring.

This double cropping trial was laid down in 1947 with the following treatments:—

Treatments

1. Normal off-season fallow.
2. Taiwan padi off-season cultivation.
3. Taiwan padi off-season cultivation manured with 533 lbs. bat guano per acre. (About 66.5 lbs. per acre P_2O_5).
4. Taiwan padi off-season cultivation manured with 1,067 lbs. bat guano per acre. (About 133 lbs. per acre P_2O_5).

Sub-treatments

(a) No manure in the main season.
(b) 533 lbs. bat guano in the main season.
(c) 1,067 lbs. bat guano in the main season.

The varieties used were Pee Bee Fun, with a maturation period of 121 days, in the off-season and Radin Kalumbong, which matures in 190 days, in the main season.

Fertilisers were applied every other year, namely in 1947, 1949 and 1951 but not in the intervening years.

Yields for the three crops planted during 1950 and 1951 are summarised in Table XIII.

Results from the 1951 off-season may be ignored as the yield was negligible due to pest damage. However, when the other yield figures are considered it is clear that bat guano applied to the main crop leads to increased yields both in the main and off-season. Differences between main treatments did not attain statistical significance.

This is a difficult experiment to review annually but it is hoped that cumulative results obtained over a series of years may yield information of value.

Table XIII.

Yield of Grain as Percentage of Mean.

Experiment B.M.7—Bukit Merah.

Season.	Treatment.				M.S.D. at 5 per cent.	Mean yield in lbs. per acre.
	1	2	3	4		
1950	—	98	99	103	N.S.	1,206
1950-51	95	95	102	108	N.S.	1,370
1951	—	119	68	113	49.3	168
	No manure.	Bat Guano single dressing.	Bat Guano double dressing.			
1950	89	100	110		6.5	1,206
1950-51	91	100	109		8.0	1,370
1951	82	93	124		23.9	168

Time of Application of Ammonium Phosphate.

There was only one experiment in this series, with the following treatments:—

A. Placement application of 300 lbs. per acre of mono-ammonium phosphate 1 to 2 weeks after transplanting.

B. Same application 6 weeks after transplanting.

C. Same application 10 weeks after transplanting.

D. Control—no fertiliser.

Fertilisers were applied in 1949 when treatments B and C gave an increased yield of 50 per cent. over control, amounting to about 1,143 lbs. of grain per acre. This trial was continued in the 1950-51 season for residual effects with no further application of fertiliser.

Yields in this last season are summarised in Table XIV.

Table XIV.

Yield of Grain as Percentage of Control.

Experiment number.	Locality.	Manure applied 1 to 2 weeks after planting.	Manure applied 6 weeks after planting.	Manure applied 10 weeks after planting.	Control. No manure.	S.E.	Mean yield in lbs. per acre.
Kn.34	Kota Bharu	90	91	89	100	5.3	2,912

Differences between treatments were insignificant and no importance should be attached to the apparent negative residual effect.

Cultural and Manurial Trials.

These trials were designed to determine how wet padi responded to a standard fertiliser dressing when applied at different depths.

Treatments were as follows:—

A. All manure ploughed in to a depth of about 8 ins.

B. Half the manure ploughed in to a depth of about 8 ins.; the other half spread on the soil surface.

C. All manure spread on the soil surface.

D. Control—no manure.

The standard fertiliser mixture contained the following ingredients:—

Nitrogen .... 47 lbs. per acre as sulphate of ammonia.
P_2O_5 .... 40 lbs. per acre as single superphosphate.
Potash .... 50 lbs. per acre as muriate of potash.

The experiment was laid down in three localities and yields of grain are summarised in Table XV.

Table XV.

Yield of Grain as Percentage of Control.

Experiment	Locality.	A.	B.	C.	D.	S.E.	Mean yield in lbs. per acre.
B.M.12	Bukit Merah	104	100	106	100	5.27	1,929
M.28	Pulau Gadong	88	94	91	100	6.89	1,040
Kn.41	Kota Bharu	129	125	126	100	6.80	2,208

As in most mechanical cultivation experiments with big plots, experimental errors were large and yield differences were insignificant at the 5 per cent. point. However, in trial Kn.41 differences were significant at about 6 per cent., so it may reasonably be concluded that there was a response in yield from the fertiliser application although method of application proved unimportant.

A somewhat similar experiment was laid down in Perak but with inadequate replication. The fertiliser dressing was the standard one already detailed and method of application was as follows:—

Treatments.	*Sub-Treatments.*
A. Deep cultivation by hand hoe.	Manure.
B. Shallow cultivation by hand hoe.	Control—no manure.

Harvest yields are summarised in Table XVI.

Table XVI.

Yield of Grain as Percentage of Mean.

Experiment number.	Deep.	Shallow.	S.E.	Manure.	No manure.	S.E.	Mean yield in lbs. per acre.
Pk. Parit 1/50	95	105	9.07	112	88	6.21	3,344

The apparent difference in yield due to cultivation treatments was insignificant and may be ignored but the increased yield due to manure was significant at about 6 per cent. It is evident, therefore, that the response to fertilisers was real but the experiment was not sufficiently precise for this result to be accepted without confirmation. There was a suggestion that, without manures, shallow cultivation gave a better yield than deep but this interaction was quite insignificant.

Varieties and Manures.

When a real response to fertilisers has been proved in any particular locality it will be important to determine whether different varieties of padi respond differentially. In the season under review there was no systematic study of this particular problem but three isolated experiments in Kelantan and Trengganu gave some information on this point.

In Trial Kn.64, which was carried out on the 1951 off-season crop of Taiwan short-term padi, treatments were as follows:—

Manurial Sub-treatments.

Time of application of fertilisers.	1	2	3	4	5	6	7	8
At planting	M	—	—	M/2	M/2	—	M/3	—
3 weeks after planting	—	M	—	M/2	—	M/2	M/3	—
6 weeks after planting	—	—	M	—	M/2	M/2	M/3	—

Varieties: A. Taichu 65
B. Pee Bee Fun
C. Goh Chee Sai

The fertiliser dressing was the standard N.P.K. application already detailed. Harvest yields are summarised in Table XVII.

Table XVII.

Yield of Grain as Percentage of General Mean.

Experiment Kn.64, Kota Bharu.

Variety	1.	2.	3.	4.	5.	6.	7.	8.	Mean.	Mean yield in lbs. per acre.
A	141	127	82	127	103	109	127	84	113	1,599
B	75	118	100	100	89	111	87	72	94	1,335
C	87	99	85	75	101	103	117	80	93	1,326
Mean	101	115	89	101	98	108	110	79	100	1,420

Differences between variety yields were insignificant but there were significant differences between the manurial sub-treatment totals (M.S.D. at 5 per cent. = 20.9). It will be seen that five manurial dressings gave a significant response but that treatments 2, 7 and 6 were the most efficient and 3 and 5 the least. It would seem, therefore, that the optimum time of application was three weeks after planting. There was some indication of a differential response amongst the three varieties to the time of application of manures, the interaction being significant at about 8 per cent. A reference to Table XVII suggests that variety A, Taichu 65, responded better to earlier fertiliser than the other two varieties.

The findings of this investigation, being determined from an off-season crop, are of somewhat limited application and the trial as such is not being repeated.

A somewhat simpler experiment was laid down in Trengganu in the main season with the following manurial and variety treatments:—

Treatments	*Varieties.*
M. Standard manurial application ploughed in before transplanting.	Sm.29
	R.C.4
O. No fertiliser.	R.S.24
	Anak Ikan Sombong.
	M.E.88

Harvest yields are summarised in Table XVIII.

Table XVIII.
Yield of Grain as Percentage of Mean.
Experiment Tr.4, Gerai.

	Sm.29.	R.C.4.	R.S.24.	Anak Ikan Sombong.	M.E.88.	Mean.	Mean yield in lbs. per acre.
M	133	99	116	103	124	115	1,806
O	94	78	90	69	94	85	1,335
Mean	113	89	103	86	109	100	1,571

There was a large and significant increase in yield as a result of manuring and there were significant differences between variety yields but the interaction was quite insignificant, there being no suggestion of differential responses to manure.

One other experiment has already been discussed in this Journal (2), namely Kn.51. It will be remembered that there were two cultivation treatments, two manurial treatments and two varieties. There was a highly significant response in yield from the standard manurial dressing ploughed in before planting and the interaction between manures and varieties was significant. The relevant yields are given in Table XIX,

Table XIX.

Yield of Grain in Lbs. per Acre.

Experiment Kn.51—Pangkal Kalong.

Variety.	Manure.	No manure.	Mean.
S.B.15	1,796	425	1,110
R.S.34	1,472	563	1,017
Mean	1,634	494	1,064

It will be noted that variety S.B.15 gave a better response to manure than did R.S.34. Although this interaction was significant it should be treated with reserve because it was necessary to use seedlings of different ages when planting this experiment.

N.P.K. Extension Trials.

A number of simple extension trials were laid down by the State Agricultural Officer, Kelantan, on smallholders' land with the following treatments:—

M. 600 lbs. per acre N.P.K. mixture applied in two applications, each of 300 lbs., at six and ten weeks after transplanting.

O. Control—no manure.

The N.P.K. mixture was a proprietary one containing the following nutrients:—

Nitrogen 11.5 per cent. or 69 lbs. per acre.
P_2O_5 8.6 per cent. or 52 lbs. per acre.
K_2O 4.0 per cent. or 24 lbs. per acre.

The method of application varied with locality but the general method was to place it in the soil at intervals of about one foot in alternate inter-rows. Application on the soil surface followed by treading in was one of the simplest methods and it was found that one man could place manure at the rate of half to one acre per day.

There were only two replicates in each locality so all yields were analysed together for the 13 wet padi experiments. Harvest results are summarised in Table XX.

Table XX.

Yield of Grain—Kn.59 Series.

	Manure	No manure.	S.E.
Yield of grain in lbs. per acre	2,257	1,523	59.0
Yield of grain as percentage of control	148	100	3.87

It will be seen that the increment due to manuring was in the region of 48 per cent. or 734 lbs. per acre.

The magnitude of the response in these trials varied with soil type, being 936 lbs. per acre on poor sand, 674 lbs. per acre on sandy clay and 709 lbs. per acre on medium clay.

These demonstrations on smallholders' land have been very greatly extended in the 1951-52 season in Kelantan and Trengganu.

Dry Padi Manurial Trials.

Dry padi investigations were restricted to the following series in Kelantan:—

(1) Time and depth of cultivation with manures.
(2) Depth of application of manures.
(3) N.P.K. extension trials.

Results from the first two series have already been discussed in this Journal (3).

N.P.K. Extension Trials.

These were confined to two localities and treatments were identical with those in the wet padi extension trials which are summarised in Table XX. The method of application in dry soil was naturally somewhat different, the manure being placed in pill form at a depth of 4 to 6 ins. below ground, beneath the roots of each clump of padi. Harvest results are summarised in Table XXI.

Table XXI.
Yield of Grain.

Kn.59 (p) and (r).	Manure	No manure.	S.E.
Yield of grain in lbs. per acre	926	553	64
Yield of grain as percentage of control	168	100	11.6

It will be seen that the application of manure led to a clear increase in yield, which averaged 373 lbs. per acre. However, this increase was not economic at present prices of padi and fertiliser.

Discussion.

This report tells a very different story from that presented for the previous season (1), as it is now evident that it is the rule, rather than the exception, for suitable fertilisers to give a response in yield on the lighter soils of eastern Malaya. Results from the placement trial are of very great value in planning further investigations, as it is clear that method and time of application, and type of fertiliser are all of importance. Even in western Malaya it seems that soluble phosphate in the

presence of nitrogen is likely to give a yield response, provided that insufficient water-control is not a limiting factor of growth. It is of particular importance that such a fertiliser can have a beneficial effect in north Kedah, where average yields exceeding 4,000 lbs. per acre are recorded.

The comparative inefficiency of rock phosphate as a fertiliser for padi is of considerable interest as its low price has made it a popular fertiliser in the past. This result will inevitably lead to a greater reliance on superphosphate and, in particular, on the concentrated form.

For the immediate future, sulphate of ammonia must remain the chief source of nitrogen for reasons of availability and price. Nevertheless, the fact that urea, nitrate of soda and ammonium phosphate can all give superior results under certain circumstances will lead to further investigations on the best type of nitrogenous fertilisers for padi. It should be remembered, however, that most padi-growing countries favour sulphate of ammonia, and results from one season's agronomic investigations are unlikely to lead to the adoption of a more expensive source of nitrogen.

Summary.

1. In the 1950-51 padi season, 107 manurial experiments were carried out in Malaya, and results from 99 of these are described in this paper.

2. In the north-eastern States of Kelantan and Trengganu it is shown that almost any form of balanced fertiliser will give an increased yield of padi, with the possible exception of those containing rock phosphate.

3. The most promising fertiliser in the west is a balanced mixture of soluble phosphate and nitrogen.

4. Conclusions from these investigations have made it possible to design a fresh series of experiments for the 1951-52 season.

Acknowledgements.

Results from most of the Kelantan and Trengganu experiments were analysed by Mr. H. K. Ashby and Mr. E. J. H. Berwick. For help with the many other statistical analyses I am indebted to Mr. Chee Sek Pan, Agricultural Assistant in the Agronomy Branch.

It should be made clear that the execution of these trials in the field involved a great deal of work, and great credit is due to all Field Branch officers, both senior and junior, for the care with which they have been carried out.

I am indebted to Mr. I Watson, Statistician, for the calculation of the consolidated analysis of variance of results from experiment K.P.1 (Table VI).

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APPENDIX

DISTRIBUTION OF MANURIAL TRIALS ON PADI STATIONS.

Name of Station.	State/ Settlement	Abbreviation	No of Trials	Soil Type
Telok Chengai	Kedah	K.P.	5	Heavy clay
Hutan Kampong	„	„	2	Sandy clay
Bukit Merah	P. Wellesley	B.M.	6	Medium clay
Tanjong Piandang	Perak	Pk.N.	1	Heavy clay
Briah	„	„	3	Medium clay
Bagan Serai	„	„	3	Fine sandy loam
Selinsing	„	„	5	Heavy clay
Talang	„	Pk.C.	6	Silty clay
Bruas	„	„	2	Medium clay
Chenderong Balai	„	Pk.S.	2	Muck overlying peat
Sungei Manik	„	„	4	Clay loam
Ulu Klawang	N. Sembilan	N.S.	1	Medium clay
Ampang Tinggi	„	„	2	Silty clay loam
Kendong	„	„	2	Fine sandy loam
Alor Gajah	Malacca	M.	1	Medium clay
Jasin	„	„	1	Black clay, sandy in parts
Pulau Gadong	„	„	6	Sandy silt
Sg. Balang	Johore	J.	1	Organic clay
Pahang Tua	Pahang	Phg.	1	Medium clay
Dong	„	„	2	Light clay
Gerai	Trengganu	Tr.	3	Medium clay
Bachok	Kelantan	Kn.	2	Coastal sand
Pasir Mas	„	„	2	Silty clay
Kota Bharu	„	„	7	Clay loam
Pasir Puteh	„	„	2	Sandy loam
Melor	„	„	3	Medium clay

PIG-REARING, FISH-FARMING AND VEGETABLE GROWING

BY

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Introduction.

The importance of pig-rearing in the economy of the Chinese squatters in Malaya cannot be over-emphasised. It has long been recognised by the agricultural authorities in this country that Malayan soils are inherently poor in nutrient salts. In the case of Chinese market gardening, which entails intensive cropping of leafy vegetables, the need for rapid replenishment of losses in soil nutrients is all the more necessary. The problem posed has, to a great extent, been solved by the Chinese squatter.

Pig-rearing by itself, however, yields only modest returns, especially so since food concentrates such as groundnut cake, soyabean cake, copra cake and bran have to be purchased and possibly imported as well. However, the Chinese squatter at a peasant level, and by traditional methods, has learnt effectively to conserve fertility within the limits of his smallholding and utilises the pig-dung for manuring his vegetable garden, fertilising fish ponds and for replenishing nutrients in padi land. Indeed, pig-rearing has become the basis for a mixed peasant economy which not only ensures a perpetual production of food but at the same time provides a cash income for the peasant.

While the pig is the essential biological or living factor in the production cycle, water is the essential physical factor. The pig needs water for consumption and has to be bathed twice a day, the vegetables need watering, the padi needs irrigating and the fish need water to live in, and the ponds in which the fish are reared also produce water plants for use as pig-food. Therefore, it must be stressed that any proposal for basing a mixed farm on a "pig economy" should be sited where there is a perennial water supply.

In Penang, close to the aerodrome at Bayan Lepas, a group of Chinese businessmen have taken the traditional peasant smallholding as a basis and have developed an intensive farm which is both organised as a business and laid out on scientific lines, incorporating the best of the traditional practices with such reasonable modern advances as are desirable. The result has been a good yield in pork and fish, with vegetables, fruit and poultry following. The farm has only been established for two years, but sufficient data has now been obtained to show how profitable it can be.

It is felt that where terrain is suitable the principles of this farm could be followed in New Villages with success. The basic principles

are traditional, but the development of those principles to cut down manpower and overheads are not usually practised. Since the fundamental basis is traditional, such a project as this should be readily acceptable to Chinese squatters who are resettled in New Villages, and if organised and worked on a co-operative basis will not only provide pork, fish, fruit, vegetables and poultry for food, but a cash profit as well.

The following account is of the farm at Bayan Lepas and will be a guide, not only of the practical problems of lay-out but in the economics as well, and will indicate some of the snags to be looked for and guarded against. Moreover, suggestions are made for alternative diets which, it is calculated, could give a better yield than that at present obtained. The members of the syndicate who own the Bayan Lepas Farm are wholesale dealers in animal foodstuffs and also have a big interest in a motor transport concern. It has to be noted therefore that both imported pig food and transport are at their command.

The farm at Bayan Lepas is in process of development. The planting of fruit trees and the keeping of poultry has only recently begun, therefore no returns are calculated from these latter. Eventually it is planned to produce pork, fish, chickens, ducks, eggs, vegetables for human consumption (the trimmings from which will be fed to the pigs and poultry), and vegetables solely for pig consumption, e.g. water kangkong (*Ipomoea reptans*), tapioca, and sweet potatoes. Fruits, such as rambutans, mangoes, citrus and bananas, (the stems of spent bananas being used as pig food when chopped up) will also be cultivated.

The Bayan Lepas Farm.

The total area of the farm is approximately 14 acres, consisting of five acres of coconut plantation and nine acres of what used to be poor class padi land.

ORGANISATION.

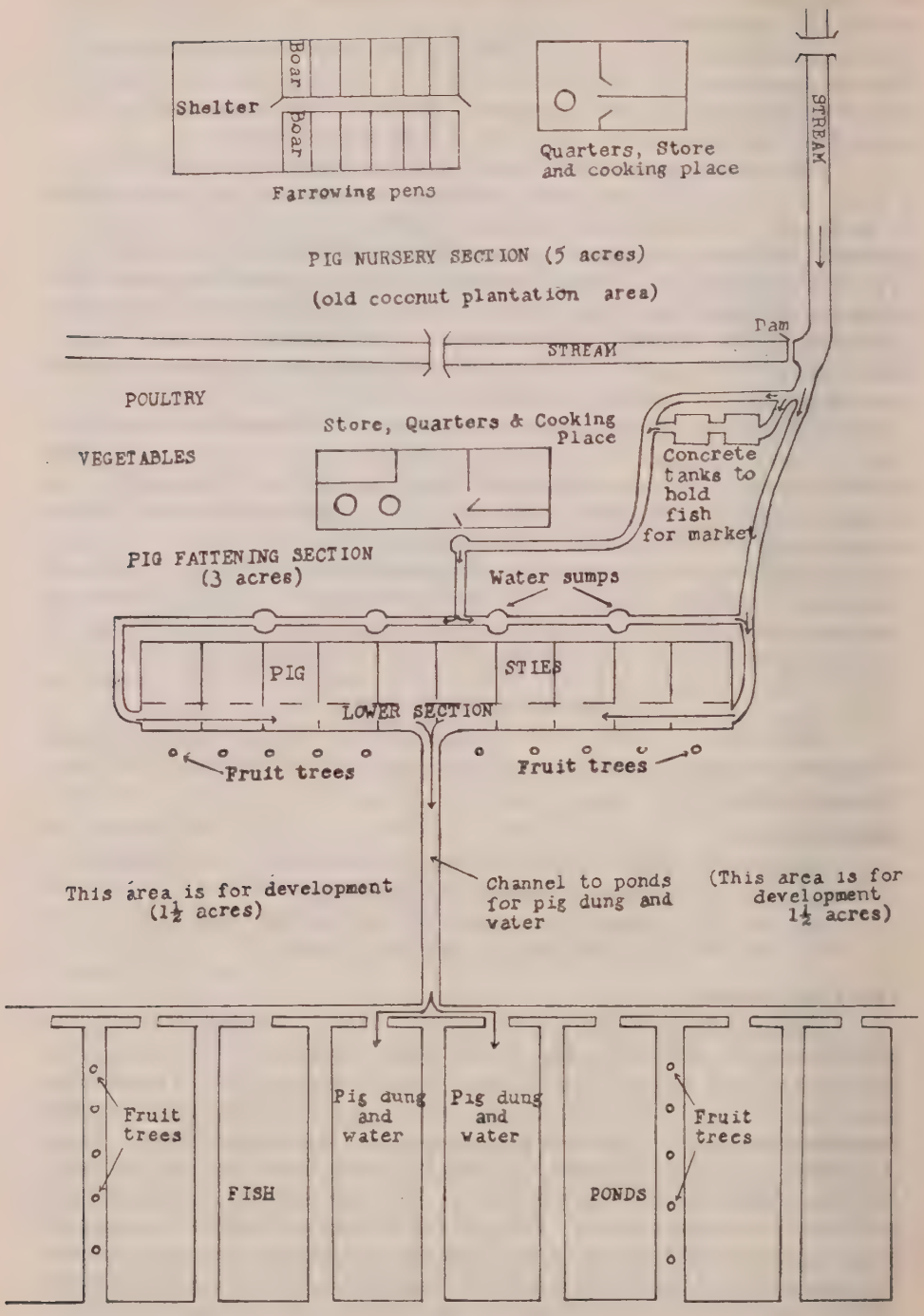
The farm is organised in three main sections (Fig. 1) as follows:—

A. The pig nursery or breeding-pig section.
B. The pig fattening or store-pig section, with poultry.
C. The fish farm, vegetables and fruit section.

THE PIG NURSERY.

This section is under the care of one man. The area is five acres of old coconut plantation, the whole being fenced in. Breeding sows and their litters are allowed a free range over this area. Farrowing pens have been built and these also form a shelter for the pigs during inclement weather. There are also two pens for the stud-boars. There is a house for the pig keeper; a store and cook-house for the pig-food. All the buildings have concrete floors. The pig sties have sand-cement brick walls and attap roofs. Being given free range within the nursery area is good for the health of the pigs, provided they are not permitted to overpopulate it, as this will lead to fouling and then worm infestations (*Helminthiasis*) and other diseases may spread. It is important to note that one of the primary factors for success is the proper cross-breeding

BAYAN LEPAS FARM LAY-OUT



FISH POND SECTION (3 acres)

Fig. 1.

of local with imported strains of pig. At Bayan Lepas this has been achieved by the purchase of two Middle-White stud boars. The sows are either local or crosses of local x Middle-White.

Buildings.

The following are the buildings in the area:—

(1) One plank and attap house for the pig-keeper.
(2) One store 20 x 20 ft. for storing pig-food.
(3) One attap shed to house a cooking stove with a cauldron for pig-food.
(4) One pig-sty with a shelter extension of concrete shelter and brick walls. There are twelve compartments, each 12 x 6 ft., two compartments for the stud boars and ten for farrowing or suckling sows. It is considered best to permit the sows to farrow on a bed of dried sand, which is laid at the time appropriate.

Stock.

The average stock maintained in the nursery section is:—

Boars	2	Middle-White
Sows	50	local and cross-bred.
Piglings	250	

Capital Costs.

Initial costs are as follows:—

5 acres of land at $200 per acre	$ 1,000
Buildings etc.	3,500
Cost of 2 boars and 50 sows	7,500
Total	$12,000

Running Costs.

Of the running costs the most important item is, of course, food. The following amounts of food were supplied to 50 sows, 250 piglings of various stages up to 3 months old and 2 boars for a two day period:—

1 bag broken rice (125 katis) at $17.00 per picul	$ 21.25
63 katis rolled oats at 22 cents per kati	13.86
69 „ Kedah bran at 13 cents per kati	8.97
96 „ groundnut cake at 17 cents per kati	16.32
50 „ copra cake at 22 cents per kati	11.00
100 „ kangkong (*Ipomoea reptans*) which is obtained from the fish ponds and is valued at $2.00 per picul	2.00
1 gallon of cod liver oil	7.20
Total cost of foodstuffs for two days	$ 80.60

1 kati = 1⅓ lbs. 1 picul = 100 katis.

Therefore the cost for one year $= \frac{30}{2} \times 12 \times 80.60 =$		$14,508.00
Cost of firewood at $1.00 per day for 360 days	$ 360.00	
Wages of pig keeper at $105 per month	1,260.00	
Transport of feed from Penang to the farm (12 miles) at an average per day of $1.50	540.00	
Miscellaneous expenses, torch-light batteries, kerosene oil for lamps etc. at $30 per month	360.00	
Total sundry running costs per annum =		$2,520.00
Total annual running costs =		$17,028.00

Income from Pig-Breeding Section.

Piglings are usually sold when they are about 20 katis in weight each. Working on the basis of seven piglings to a litter and that a sow farrows twice in a year, the total yearly production of piglings for 50 sows will be 50 x 14 = 700. The piglings are sold by weight. The total weight of piglings produced, assuming that they are sold when they average 20 katis each = 700 x 20 = 140 piculs.

To sale of 700 piglings of 140 piculs at $130 per picul = $18,200.00

Annual running costs =	$17,028.00
Nett profit for year	$ 1,172.00

The interest on capital and running expenses and depreciation have not been accounted.

PIG FATTENING OR STORE-PIG AND POULTRY SECTION.

This section, which has an area of 3 acres, is under the charge of one man with two assistants. A start has only recently been made with the poultry section, consequently no figures are available.

Buildings.

There are three sets of buildings in this section, the pig-sties, labourers lines and fodder store, two cooking stoves and two cauldrons.

The pig-sties have concrete floors, pre-cast, reinforced concrete slab walls and an attap roof. There are in all 20 compartments each measuring 12 x 18 ft. Each compartment is divided into two sections, one of which is at a lower level than the other. The higher section, measuring 12 x 12 ft., is the normal living section for the pigs. Running water passes through the lower section of all the compartments, so that the pigs are able to drink and cool themselves at all times of the day. The running water also carries away the dung, which is distributed to eight fish ponds by a system of concrete drains or may be diverted to vegetables. At this farm, the water runs from each end of the line of sties through the lower section of each sty in turn, and is carried away

Sow and piglings feeding on uncooked *Ipomoea reptans* (*Malay*: *Kangkong*).

A close view of the concrete sties in the store-pig section.

A general view of the pig-sties in the store-pig section. The drain supplying water to the lower section of the sties is not shown in the picture.

Feeding time for the store-pigs.

from the middle. Thus, those sties nearer the centre receive water which has already been fouled in the preceding sties. This could easily lead to a spread of disease and is considered unhealthy. Experience has shown, therefore, that it would have been better to provide each sty with independent supplies of running water, and this can quite simply be arranged.

The average number of pigs per sty is eleven.

A normal distribution of stock is to have half the pigs of one weight and the other half twice that weight. At the end of March, 1951, there were 220 pigs—116 of about 1 picul each and 104 of about 60 katis each.

Capital Costs.

Land. 3 acres at $200 per acre	$ 600.00
20 pig-sties 18 x 12 ft. with 2 in. concrete floor	6,400.00
Labourers' lines and store	1,000.00
2 cooking stoves	600.00
Total capital cost	$8,600.00

Running Costs.

Food per day.

Food per day for 220 pigs; 116 of 1 picul and 104 of 60 katis each.

180 katis	broken rice at $17 per picul	$ 30.60
100 „	bran (1st quality)	15.70
90 „	groundnut cake	15.30
75 „	ground oats	11.00
50 „	copra cake	11.00
15 „	protein (fish)	2.70
200 „	kangkong—from fish ponds at $2 per picul	4.00
	Total fodder costs per day	$ 90.30

Cost per annum.

Cost of fodder for one year at $90.30 per day	$32,508.00
Cost of firewood at $3 per day	1,080.00
Wages of 3 labourers at $105 p.m.	3,780.00
Transport of fodder from Penang to farm at average of $2.50 per day	900.00
Wages for part-time overseer at $100 p.m.	1,200.00
Incidental expenses at $30 p.m.	360.00
Total running costs for one year	$39,828.00

It is possible to fatten each lot of 220 piglings from 20 to 110 katis each in six months. Therefore the total number of store pigs fattened per annum is 440.

Cost of 440 piglings from breeding section of 20 katis each at $130 per picul (paper transaction, see previous section)	$11,440.00
Therefore total annual ruuuing costs including stock	$51,268.00

Income.

The present price of fattened pigs is $110 per picul.	
440 pigs of 110 katis each at $110 per picul	$ 53,240
Total expenses	51,268
Nett profit or income	$ 1,972

FISH FARM.

The total area of the fish farm is 3 acres, 2.65 acres of which is the actual area of the ponds. The depth of the ponds is from 3½ to 4 ft. and the depth of the water 3 ft. The ponds, of which they are eight, are sited in low lying land. Water, tapped from the nearby stream is run through the sties of the pig fattening section and thence to the ponds along concrete channels. The fish ponds were stocked in December, 1949, with 16,500 of an African fish, *Tilapia mossambica,* which were distributed in six of the ponds, and four species of carp (*Ctenopharyngodon idellus; Aristichthys nobilis; Hypophthalmichthys molitrix* and *Cyprinus carpio*) were placed in the other two ponds in February, 1950.

The fish were, at first, irregularly fed with rice bran. In April, 1950, pig manure became available from the pig-fattening section and this rapidly caused a luxuriant growth of algae, diatoms and crustacea (all microscopic life) on which the fish fed, and feeding of the fish with bran was stopped. At the same time, kangkong (*Ipomoea reptans*) was introduced into the ponds. This plant grew well and within six weeks of planting it was possible to harvest two piculs of the vegetable daily as pig fodder. At peak production eight piculs of kangkong per day were harvested from the fish ponds. It is important to note that the Health Department have kept a careful watch on the ponds and, because the young of the fish *Tilapia* are effective larval feeders, there has been no undue breeding of mosquitoes in the roots of the kangkong.

Predators.

Otters entered the farm and caused havoc, and trapping and shooting proved ineffective. The nuisance was finally controlled in September, 1950, by stationing two caretakers with dogs in the pond area by night and surrounding it by wire netting.

The ponds were harvested in February, 1951, for the bulk of the fish, i.e. six months after really effective fish-rearing had been established. Although the ponds had been stocked one year previously, feeding, pests and predators had all been militating against a good yield. It is to be noted, however, that quantities of young fish were regularly taken from the ponds for feeding the pigs and the employees of the farm took fish as their "perks".

Concrete drains taking manure from the pig-sties to the ponds. Note banana plants in the fore-ground.

A nice specimen of the common carp (*Cyprinus carpio*). Note the shallow depth of the pond.

Luxuriant growth of *Ipomoea reptans* and *Pistia stratiotes* over one of the ponds.

Note luxuriant growth of *Ipomoea reptans.* The young shoots are harvested for human food and are relished by the cosmopolitan races in Malaya.

Capital Costs.

3 acres of land at $200 per acre	$ 600.00
Construction of ponds and channels (Earthwork at contract rate 72 cents per cu. yard)	9,000.00
Fencing	2,000.00
Total capital costs	$11,600.00

Running Costs.

2 caretakers at $105 per month	$ 2,520.00
Cost of fry	2,000.00
Total annual running costs	$ 4,520.00

Income.

In addition to fish for consumption as human food, for the pigs and for the staff (this latter is not accounted), over one picul of the Malayan *ikan aruan* (*Ophiocephalus striatus*) was harvested.

32.48 piculs of Tilapia at 50 cts. and 70 cts. per kati	$ 1,665.00
11.82 piculs of carp at $1.20 per kati	1,414.00
10 piculs of fish fed to pigs at $28 per picul	280.00
1.30 piculs of aruan (*Ophiocephalus striatus*)	100.00
1,240 piculs of kangkong at $2 per picul	2,480.00
Total receipts	$ 5,939.00

Total income	$ 5,939
Total expenses	4,520
Net income or profit	$ 1,419

It is to be noted that the total production of fish was approximately 65 piculs from an area of 2.65 acres for a period of 12 months from the date at which the ponds were fully stocked, in spite of the heavy depredations caused by otters which continued from April to September, 1950. This is approximately 3,260 lbs. of fish (recorded by weighing) to the acre in the year.

SUMMARY OF FINANCES.

Capital Costs.

A. Pig nursery section	$12,000.00
B. Pig-fattening section	8,600.00
C. Fish farm	11,600.00
	$32,200.00

Running Costs per annum.

A.	Pig nursery section	$17,028.00
B.	Pig-fattening section	51,268.00
C.	Fish-farm	4,520.00
	Total running expenses	$72,816.00

It should be noted that since stock from A and B are sold every six months, the actual money invested in running these two sections would be half that shown; it is reasonable therefore to assess this figure at $\frac{A}{2} + \frac{B}{2} + \frac{C}{2}$ = $36,408 for the first six months and $\frac{A}{2} + \frac{B}{2} + C$ = $38,668 for the second six months, i.e. a maximum of $38,668 out for running expenses at any one time.

Income.

Gross Income.

A.	Pig nursery section	$ 18,200
B.	Pig fattening section	53,240
C.	Fish Farm	5,939
	Total annual income	$ 77,379

Nett Income.

Total annual income	$ 77,379
Total annual expenditure	72,816
Nett annual income	$ 4,563

This nett annual income represents 14.2 per cent. on capital outlay of $32,200, 6.2 per cent. on total annual running expenses of $72,816 and 11.8 per cent. on actual maximum cash outlay at any one time for running expenses during the year of $38,668.

Depreciation and maintenance have not been accounted in the above figures.

ALTERNATIVE DIETS.

It is considered that in many areas where an intensive farm of this nature might be established, the imported dry foodstuffs would not be readily available. Therefore two alternative diets for fattening and breeding are quoted, using other foods available in Malaya. There are yet further foods which may be obtained and consultation with Veterinary or Agricultural officers would indicate their value. The first of the two alternative diets is suitable for the first 2½ months of pig fattening only and not for final fattening and breeding; the second is suitable for the two latter phases.

First Alternative Diet for Piglings.

The following average daily ration is calculated for 220 piglings 2½ to 4 months old, of total 5,000 lbs. liveweight.

Broken rice	130 lbs. at $17.00 per picul	....	$ 16.50
Rice polishings	15 lbs. at $15.70 per picul	....	1.77
Coconut cake	25 lbs. at $22.00 per picul	....	4.13
Soya bean cake	55 lbs. at $17.00 per picul	....	7.03
Guinea grass	50 lbs. at ½ cent per lb.	....	0.25
Palm oil	5 lbs. at 60 cents per lb.	....	3.00
Banana stem	100 lbs. at ¾ cent per lb.	....	0.75
Dried fish (minerals)	2.5 lbs. at $10.00 per picul	....	0.19
	Total cost for one average day	....	$ 33.62

Second Alternative Diet for Breeding Pigs.

This average daily ration is for 52 pigs 4 to 6½ months old, of total liveweight of 8,500 lbs.

Ubi kayu	425 lbs. at $ 5.00 per picul	....	$ 16.00
Rice polishings	51 lbs. at $13.00 per picul	....	5.00
Coconut cake	51 lbs. at $22.00 per picul	....	8.44
Soya bean cake	77 lbs. at $17.00 per picul	....	9.84
Palm oil	9 lbs. at $ 0.60 per lb.	....	5.40
Dried fish (minerals)	4 lbs. at $10.00 per picul	....	.30
	Total cost for one average day	....	$ 44.98

Both the above diets must be adjusted to the age, size, and number of pigs, and the rate of feeding must be adjusted accordingly. The first diet, for pigs 2 to 4½ months old, should average 3½ lbs. per day, dry weight, per pig, increasing in the ratio 2 : 3 : 4 for each month. The second diet, for pigs 4½ to 7 months old, should average 7½ lbs. per day, dry weight, per pig, increasing in the ratio 4 : 5 : 6 for each month.

In the second diet ubi kayu may be replaced to some extent with sweet potato.

These diets are a guide and may, of course, be varied.

GENERAL.

On the Bayan Lepas farm a further development of the remaining three acres is now underway for fish breeding, vegetable growing, fruit growing and poultry.

Fruit trees, such as rambutans and mangoes, are planted on the bunds between the ponds. Bananas are planted round the paths. All these fruits are selected stock.

The free range for the piglings should be selected in an area where trees which cannot be harmed by the piglings grow. Thus, at the Bayan Lepas farm there is a regeneration of the soil and fertilisation of the coconuts in the breeding area.

Surplus piglings not absorbed by the farm may either be sold to other pig-rearers or sold on the luxury market as food.

All piglings transferred for fattening are, according to sex, either spayed or castrated to aid the fattening rate.

When intensive cultivation is practised, disease may spread rapidly. A look out should be kept for this.

The fish-rearing gives a higher return on outlay than pig-rearing; the return recorded here would have been higher had there not been severe attacks by otters.

The two caretakers have now been dispensed with and the men who look after store-pigs also look after the fish ponds.

All ponds should be emptied before restocking to clear predatory fish such as aruan and keli.

The Bayan Lepas farm is still in the formative stage, its main returns to date being from fish and pigs. The extension of the farm's activities with little more capital outlay will enable a higher return to be obtained in subsequent years. It also might be possible to economise with slightly less elaborate construction. The advantage of the Bayan Lepas buildings is that maintenance will be low.

NOTES ON CURRENT INVESTIGATIONS, APRIL TO JUNE, 1952.

Compiled by the Acting Chief Research Officer and the Senior Agronomist.

Padi.

1. RESEARCH.

Variety Selection.

With the exception of Acheh Puteh selections (Selangor), analysis of selection work has been completed and the following number of lines are being carried forward:—

Selections	1951-52	1952-53	Localities
Serendah Kuning	67	50	Kendong, Ampang Tinggi and Ulu Klawang, Negri Sembilan.
Nachin	75	42	Pulau Gadong, Malacca.
Siam	184	75	Pulau Gadong, Malacca.
Mayang Sa Batil	90	60	Genting, Province Wellesley.
Seraup	300	99	Titi Serong, Perak.
Radin Ebos	170	83	Telok Chengai, Kedah.
Anak Naga	1,010	518	Kota Bharu, Kelantan.
Mayang Sa Gumpal	F.S.*	F.S.	Jelawat, Kelantan.
Seri Raja	—	F.S.	(New project) Talang and Simpang Tiga, Perak.
Kontor	—	F.S.	(New project) Bukit Merah, Province Wellesley.

Work has proceeded satisfactorily with the majority of these projects. The foundation stock of Mayang Sa Gumpal at Jelawat failed owing to *"Penyakit merah"* and will have to be regrown for a further season before selection commences. Mayang Sa Batil at Genting was attacked by the same disease, resulting in a temporary reduction in tempo of selection.

Selection in Serendah Kuning and Nachin is reaching the final stages. A final selection trial (balanced lattice square) of 15 Serendah Kuning ear row selections and mass selected strains has been laid down at the three Negri Sembilan stations, and a trial of 24 Nachin selections at Pulau Gadong. While these trials will not be completed until 1955, if results from the first season confirm present conclusions, extension trials can be laid down in 1953 and seed bulked for release in 1954.

Hybridisation.

Seed of four *indica* x *japonica* crosses has been received from Cuttack, India, under the International Rice Commission scheme and will be sown at Pulau Gadong together with local hybrid material in the coming quarter.

* Foundation stock.

Time of Sowing Experiments.

Small cages have been erected at Kota Bharu, Kelantan, and Temerloh, Pahang, and pilot experiments laid down to determine the effect of a limited range of sowing dates on yield. A large cage (¼ acre) at Pulau Gadong is required for a proper attack on this problem; this, it is hoped, will be erected next year.

Survey of Nutrient Content of Padi Crops.

In connection with the survey of the nutrient content of padi crops throughout the Federation, 300 samples of padi straw and ears have been received for analysis from Kelantan, Perak, Province Wellesley and Malacca. The analyses of these samples are in progress.

Pest Control.

Five shipments of Tachinid puparia from Trinidad have now been received, and a total of over 900 flies (*Paratheresia claripalpis* Wulp.) have been released in a carefully selected area near Bukit Mertajam, Province Wellesley. Unfortunately the padi planting was behind schedule and the expected amount of half-grown plants was not available. It has been found best to take the puparia by day train as soon as flies begin to emerge and then release about one hundred at a time in the early morning when they are sluggish, thereby increasing the chances of mating. Releases later in the day mean that the parasites fly away rapidly and the sexes are therefore dispersed before mating.

An attempt to rear *Paratheresia* on larvae of *Sesamia inferens* (Walk.), the only Noctuid stem borer, has not so far been successful.

2. Agronomic Investigations.

Wet Padi.

Harvest is complete in all localities and 70 per cent. of experimental results have now been received. Statistical analysis of these results is well in hand and should be complete before the end of 1952.

In the "Type and Depth" series of manurial trials, some most interesting results were obtained in north Kedah where 50 lbs. of nitrogen, as sulphate of ammonia applied eight weeks after transplanting, increased the yield of grain by 602 lbs. per acre at Telok Chengai and 1,175 lbs. per acre at Hutan Kampong. At both localities sulphate of ammonia was significantly superior to nitrate of soda but placement in the soil showed no superiority over broadcasting the fertiliser on to the surface of the soil. It should be noted that both experiments, including the control plots, received a basic dressing of 67 lbs. per acre P_2O_5 as double superphosphate.

An experiment designed to test whether the additions of sulphate to the soil have any harmful effect on the padi crop has so far given negative information on this problem. However, this investigation has yielded unexpected information of great interest and importance at two localities, where the application of 78 lbs. per acre of calcium in the form

of gypsum, chloride or carbonate resulted in significant increases in yield of grain at Pulau Gadong, Malacca, and Bukit Merah, Province Wellesley. At the former locality the increment over control ranged from 152 to 206 lbs. per acre, and 338 to 578 lbs. per acre at Bukit Merah. The cost of the carbonate dressing using ground limestone was, of course, negligible.

In a depth of cultivation and double-cropping trial at Bukit Merah, harvest results from the main season of 1951-52 indicated that deep cultivation was superior to shallow cultivation. Furthermore, the treatment combining off-season fallow and buffalo cultivation in the main season proved inferior to shallow mechanical cultivation. This result is not necessarily applicable to all soils in this area.

Planting programmes for the 1952-53 season have been prepared. There will be a large increase in manurial trials in Kedah and Province Wellesley.

Dry Padi

A factorial manurial experiment at Melor, in Kelantan, has indicated that the optimum manurial dressing during the very dry 1951-52 season was approximately 47 lbs. per acre of nitrogen and 40 lbs. per acre of phosphoric acid. There was an indication that, when twice these amounts were applied, the depressing effect of excess P_2O_5 was more marked than that of nitrogen. Yields were low because of the comparative failure of the monsoon, the best yield being 1,218 lbs. per acre of grain from the n_1p_1 treatment as compared with 624 lbs. per acre from the n_0p_0 treatment. Potash increased straw weight without affecting yield of grain.

Information from other trials has been similarly reduced by low yields resulting from the abnormally dry season.

Cacao.

1. Research.

Amelonado.

Propagation has been actively continued, progress in the past quarter being:—

	Cuttings	Rooted	Hardened
To the end of May	1,555	921	732
June	460	—	—

The 66 pods harvested from Field 44 at the Federal Experiment Station, Serdang, gave 2,613 good beans, an average of 39.6 beans per pod. Germination has been up to standard, most pods germinating over 80 per cent.

The Herrania and Upper Amazon Amelonado from Pulau Tekong Besar, the Isolation Station off Singapore, have been received at Serdang in good condition.

Trinitario.

Stocks include 209 buddings of Indonesian progenies of which 103 are ready for delivery to Jerangau Estate and 79 more recently budded have not yet shot. A further batch should be ready in September.

Compatibility tests have been commenced on the Indonesian Trinitario material, though the plants are young and fruit-set is still irregular.

Pest Control.

Rather severe damage to shoots was examined at the Federal Experiment Station, Serdang, and found to be due to *Helopeltis theobromae* Miller, although sun scorch caused a more obvious form of injury. The plants were "fogged" with D.D.T. using a "Dynafog" fog applicator. This pest was also prevalent on a hedge of annatto (*Bixa orellana*).

2. Agronomic Investigations.

Excellent growth of young cacao continues to be recorded from a co-operative trial on an estate in Krian, north Perak. The soil is a well-drained alluvial clay. On similar soil at Degong Agricultural Station growth has been comparable.

Two experiments at Rembau Agricultural Station, Negri Sembilan, have been cancelled—one because of poor uneven growth, the other because the land was required for a building site by the local administration.

One co-operative trial on a Negri Sembilan estate and one in Selangor have been abandoned; the first because of poor growth, the second because of neglect consequent on the activities of communist terrorists.

At the Federal Experiment Station, Gajah Mati, in north Kedah, seedlings of *Erythrina suberosa* have shown excellent growth and this species should prove a useful cacao nurse crop in the north of Malaya. Further south the allied *E. subumbrans* is to be preferred.

Oil Palm.

1. Research.

Selection and Breeding.

Pollination has been continued on 14 dumpy palms (8 first selections and 6 seconds), 16 tall palms and one backcross. Forty pollinated bunches and 32 control bunches have been reaped. Of the first 31 pairs reaped, the assisted pollinated bunches show a slightly higher percentage (plus 2.1 per cent.) of clean fruit. This difference is probably insignificant and a considerably larger number of bunches must be treated before conclusions can be drawn.

Two tubes of *pisifera* pollen (Palm 103.3) have been received from Nigeria and will be used on two good dumpy and two good tall palms.

Leaf Analysis.

This investigation now includes the five families of palms E97, E152, E207, E216, and E268. With the inclusion of the two additional families E152 and E216, this area has been divided into five randomised

"Dynafog" in operation in cacao area at the Federal Experiment Station, Serdang, May, 1952.

blocks of five plots each. Each plot of eight palms is further split into two sub-plots of four palms each. Half the number of sub-plots will continue to receive the standard fertiliser dressing half-yearly and the remaining sub-plots the same amounts of N.P.K. and Mg, but without calcium. This modification in the experiment has been introduced because the results obtained so far have indicated that the calcium content of the ash would seem to be directly related to ' bronzing', being highest in the most severely 'bronzed' palms, while the potassium content is highest in the healthy palms. There appears to be, also, a negative correlation between potassium and calcium, suggesting an 'antagonism' between these two nutrients.

During the quarter, altogether 50 further leaf samples have been taken on two occasions at an interval of 3 months. The analysis of the second series of samples is still proceeding.

Oil Palm at Various pH Levels.

The pot experiments, using good jungle soil and liming at the rate of 10 and 23 tons per acre, are still in progress. Observations during the previous quarter would seem to confirm the view that the oil palm will grow best in acid soils of about pH 4.0. However, during the current quarter, the palms growing in the soil treated with 10 tons lime per acre have outgrown the control palms. The pH of the soil is just on the alkaline side. The palms are now 20 months old. The continuance of this experiment to maturity of the palms is important, in view of the results of leaf analyses reported above.

Effect of Excess Aluminium.

A repeat experiment to test the effect of high concentrations of aluminium sulphate on oil palm seedlings grown in a hydroponic solution has been started. The concentration of aluminium sulphate in the solution is still low and no signs of ill effects are yet perceptible in the palms.

Pest Control.

Orthocraspeda trima was reported attacking two year old palms in Johore in June—this crop is rarely chosen for attack by this species of nettle grub.

Severe damage was caused to seedling dumpy palms on an estate in north Perak by the ant *Pheidologeton nanus* Roger, which hollowed out the seed and tunnelled the young stem. The remedy suggested, dusting with 6.5 per cent. BHC, gave good control.

2. Agronomic Investigations.

A large factorial manurial trial has been laid down on an estate in Selangor and the first application of fertilisers was made in March-April, 1952.

At the Federal Experiment Station, Jerangau, in Trengganu, 17 acres of jungle have been felled for a new oil palm progeny trial.

Coconut.

1. RESEARCH.

Pest Control.

Artona. An outbreak of this pest on smallholdings in Sungei Puteh, Mukim of Ulu Selama, Perak, was reported on the 10th May and was visited by the Agricultural Assistant, Krian. About 400 palms of approximately 25 to 30 years of age had been attacked, but no report had been made until some 3 months after the outbreak was first first observed by the owners and, at the time of the Agricultural Assistant's visit, no larvae were found.

On the 27th May, an outbreak was reported on an estate in Province Wellesley. This outbreak was first noticed on the 7th May, when about 6 acres were attacked, but this had increased to 50 acres by the 3rd June when the Entomologist visited the area. Very few larvae were found and no reliable indication of percentage parasitism could therefore be obtained. It would seem, however, that the principal parasite present was the Braconid *Apanteles artonae* Rohw. and not *Ptychomyia*. A hitherto unrecorded hyperparasite, which attacks the *Apanteles*, was present in some numbers. There was also some mortality caused by the fungus *Beauveria bassiana*, formerly known as *Botrytis necans* Massee. Caterpillars were again observed on about the 20th June, and a consignment was forwarded to Headquarters. Many of these apparently escaped in transit, but of 63 living caterpillars received none was parasitised.

Another estate in Province Wellesley suffered an outbreak of *Artona* which was first reported on the 18th June, about 5 acres being severely attacked. A field count of larval parasitism showed only between 10 and 20 per cent. attacked by *Ptychomyia*, but cocoons showed about 40 per cent. parasitism. Material forwarded to Kuala Lumpur showed just over 13 per cent. parasitism by *Ptychomyia*, 4 per cent. by *Apanteles*, but more than 50 per cent. of the *Apanteles* were attacked by a hyperparasite, the same as that found on the estate mentioned in the preceeding paragraph.

Tea.

A manurial trial at the Federal Experiment Station, Cameron Highlands, has been pruned and tipped and the first fertiliser dressing was applied in April. A uniformity trial for a second experiment is still in progress. At the same locality, growth of the ground creeper *Eupatorium riparium* has been very promising.

A manurial experiment at Serdang was concluded in April after running for four years. Experimental yields in the fourth year were as follows:—

N_2PK — 8,431 lbs. per acre green leaf or 1,803 lbs. per acre made tea
N_1PK — 7,206 lbs. per acre green leaf or 1,541 lbs. per acre made tea
N_0PK — 5,699 lbs. per acre green leaf or 1,219 lbs. per acre made tea

The annual applications of nitrogen were 600, 400 and 0 lbs. per acre of sulphate of ammonia respectively. Since it is evident that the incre-

ments due to the two dressings of sulphate of ammonia were 584 and 322 lbs. per acre of made tea, it is clear that these applications were economic and it appears probable that even higher rates of nitrogenous manuring would be beneficial.

Fibres.

1. Research.

Sixteen bundles of Manila hemp were received from two estates for assessment. These samples were generally up to the standard in tensile strength but of varying appearance and length.

A small bundle of *Urena lobata* stems received from the Senior Agronomist yielded a fibre which, although not as soft, nevertheless could be a good substitute for jute. The fibre could be easily won from the stems by retting. The percentage of fibre in the stem was satisfactorily high.

A sample of Rozelle fibre from the Melor Experiment Station, Kelantan, was dark greyish in colour, hard and lacking in lustre, while the sample from Kota Bharu Experiment Station, Kelantan, was white, soft and lustrous.

Disease Control.

Manila hemp. A serious stem rot has been reported from an estate in Pahang. The same disease has also recently been observed on an estate in Selangor as well as at the Federal Experiment Station, Serdang, and (on banana) in Kuala Lumpur. The outer leaf sheaths of the pseudostem become brown and rotten, and as a result the outer leaves die. As the disease extends inwards more leaves die until only one or two may be left. The outer layers of the pseudostem are rendered useless for fibre extraction. The roots are also attacked. On affected pseudostems, mushroom-type fructifications appear; these are formed by the causal fungus *Marasmius stenophyllus*. Control largely depends on reducing humidity as much as possible.

Further investigation of the bacterial disease of Manila hemp reported last quarter has not been possible, the disease having been quiescent during the recent dry weather.

2. Agronomic Investigations.

Bangulanon Manila hemp interplanted with young oil palms on an estate in Selangor sited on alluvial muck has shown very promising growth indeed, with lengths of stem up to 12 ft.

A Manila hemp spacing and rubber interplanting experiment on another estate in the coastal area of Selangor has suffered numerous casualties from wild pig.

A jute variety trial has been laid down on a Selangor Agricultural Station situted on alluvial, organic clay. Since strains from a mixed population are growing true from seed it is apparent that the degree of cross pollination is negligible. At the same locality a manurial trial was

a failure because seed did not germinate; it is to be re-sown with the promising Segama variety as soon as weather permits.

Growth has been good in a ramie variety trial at the Federal Experiment Station, Kuala Lumpur.

Pineapple.

1. RESEARCH.

Selection.

The survey of variation in fruit characters was started at canneries and plantations in Johore and Selangor in April and is continuing throughout the present season.

Selections are being made in the commercial and small growers' plantations in Johore and Selangor from plants of the Singapore Spanish variety showing desirable canning characters. Selected clones will be established at Jalan Kebun, Selangor.

Suckers of the Sarawak pine are also being collected from all districts for inclusion in the selection programme.

Arrangements have also been made to import 1,500 suckers of the Smooth Cayenne variety from Australia to determine their value for canning when grown in this country.

2. AGRONOMIC INVESTIGATIONS.

Plans have been made to repeat all Johore experiments at the Federal Experiment Station, Jalan Kebun, on the Selangor coast. The experimental programme is an ambitious one.

It is reported from Johore that a dilute foliage spray of 3¾ lbs. per acre of copper sulphate has led to improved appearance of plants. This observation will require to be confirmed by increased yield and reduced disease rate.

Fodders.

Pasture Grass Experiments.

The analytical work in connection with the several experiments on pasture grasses at the Federal Experiment Station, Serdang, has continued and a total of 244 samples has been analysed.

Vegetables and Foodcrops.

1. RESEARCH.

Soyabean.

The 47 strains of Java soyabeans previously selected have been grown in multiplication plots and are now to be included in a variety trial before further single plant selection is carried out. Seven bulked selections are being maintained for future selection work.

Groundnut.

There are 22 strains being maintained for future selection work.

Sweet Potato.

The collection is to be reselected for strains giving a high yield of 'tops', and arrangements have been made for yields at two months to be recorded in the current planting of the collection at Serdang.

Banana.

In an area at the Federal Experiment Station, Serdang, where bananas (variety Embun) are being used as shade for cacao, the bananas have been heavily attacked by Panama disease (*Fusarium oxysporum* f. *cubense*). A trial is being started in this area to test the resistance of some of the more common banana varieties to this disease.

2. Agronomic Investigations.

In a small-scale variety trial conducted at the Federal Experiment Station, Kuala Lumpur, the maize variety Salisbury White of Southern Rhodesian origin has shown very considerable promise and has easily outyielded the local yellow flint maize. Yields of grain for hybrids ranged from 4,437 to 5,663 lbs. per acre whereas the once-grown open-crossed variety gave 4,203 lbs. per acre. By comparison the local control variety gave 2,993 lbs. per acre. Local production of hybrid maize is not envisaged at present but mass selections will be made from the mixed hybrid progeny.

Soils.

'Available' Phosphate and Potash.

A large number of soil samples have been examined by various methods for 'available' phosphate and potash and so far there seems to be no correlation between the results from these methods. However, it seems that the modified Neubauer method is most suitable for the determination of the 'available' potash.

A further lot of 200 samples, representative of the various soil types collected since the end of the war, has been selected for testing. So far 86 samples of these soils have been planted with padi. The 15 days old seedlings will be analysed micro-chemically by the Chemistry Division for the amounts of 'available' phosphate and potash.

Corrosive Soil.

Four samples of coastal alluvial soil from Krian have been received from the Director of Public Works, Federation of Malaya, for analyses in connection with the phenomenon of electrolytic corrosion of buried metallic structures. These analyses are in progress.

These soil samples have also been examined for the presence of sulphate-reducing bacteria.

Miscellaneous Pests.

Attap.

Consequent upon the huge rebuilding programme necessitated by resettling squatters, attention has been directed to the danger of damage caused to attap roofs by caterpillars of *Herculia nigrivitta* Walk. and *Simplicia caenusalis* Walk. Damage to roofs of huts in two military camps has been severe.

The cure is the use of mature leaves and the proper soaking of the freshly cut leaves for at least 4 weeks so as to remove the starch and other food materials. An investigation to determine the rate of removal of carbohydrates from freshly cut leaves by steeping in water is in progress.

Cloves.

Laboratory tests with 1.2 per cent. Dieldrin against two species of borer beetle *Aphrodisium brevicorne* Franz and *Niraeus tricolor* Newm., showed that contact for 5 mins. with treated branches caused death on the third day up to two weeks, and on the sixth day up to five weeks after the insecticide had been applied.

NOTES ON EXTENSION WORK, APRIL TO JUNE, 1952.

Compiled by the Acting Chief Field Officer.

Padi.

Manuring.

During the 1951-52 season, 316 padi manurial trials were laid down on smallholders' land in Kelantan and Trengganu. Of these, 290 were with wet padi, 233 in Kelantan and 57 in Trengganu, and 26 with dry padi, all of which were in Kelantan. The results of these trials have now been analysed and it has been found that an application of 200 lbs. of a standard manurial mixture per acre gave an increase of 80 to 100 gantangs of padi. The cost of the fertiliser is approximately $33 per acre, which is equivalent in value to some 50 gantangs of padi. It will be seen therefore that full cost of the manure can be recovered in the first season with a reasonable amount of profit. In this connection it must be emphasised that the 1951-52 season was not a favourable one for wet padi on the East Coast and it is possible that in better seasons the increase in yield may be even greater.

The importance of these results is considerable, as there are some 224,000 acres of padi land in Kelantan and Trengganu, most of which is likely to respond to this fertiliser mixture. If all was manured, the increase on the basis of this season's figures would be as much as 20,000,000 gantangs of padi or 30,000 tons of rice. The State Governments are fully aware of the necessity for organising the supply of this manure, and in Kelantan, for example, the help of the Rural and Industrial Development Authority has been requested to ensure adequate transport facilities.

Deep Ploughing of Dry Padi Land.

Dry padi cultivation experiments started in Kelantan in the 1934-35 season and it was soon discovered that deep cultivation by changkolling to a depth of about one foot resulted in an increase in yield of 50 to 100 per cent., and that there was a residual effect in the following seasons. At that time, however, there were no means of doing deep cultivation at an economic cost and so the results of the experiments could not be put into practice.

In 1948, tractors and implements became available and investigations into mechanical cultivation began. It was soon found that deep cultivation could be satisfactorily performed and that the results were similar to those obtained by hand methods. The increase in yield and the ease of the operation compared with the heavy work normally involved, impressed the local cultivators and in the 1950-51 season a pilot scheme was conducted on 43 acres of their land. This resulted in an

increase of some 60 per cent., that is to say the yield rose from 120 to 200 gantangs per acre. In this pilot scheme the rayat paid only the running costs of the tractor of $7.41 per acre, and the value of the increased crop was some $50 per acre.

As there are some 29,000 acres of dry padi in Kelantan, these experimental results could be put into practice on a large scale, and if the whole area were to be deep ploughed, the possible increase would be some 2½ million gantangs of padi or almost 4,000 tons of rice. The Rural and Industrial Development Authority provided two tractors for the 1951-52 season, but at most only 300 to 400 acres were ploughed, possibly owing to the increased charge, as maintenance and depreciation on the tractors were added.

There is every likelihood that these results will also apply in Trengganu where there are 10,000 acres of dry padi.

Mechanical Cultivation.

The number of tractors being used in smallholding agriculture continues to increase. As a general rule, pilot schemes are conducted by the Departments of Agriculture in the various States and Settlements, using their own tracors. When it has been shown that any scheme can be worked economically, it is handed over to other organisations to continue as an economic project. For example, at Padang Kangsa in Pahang, two State Department's Ferguson tractors were used to train drivers and to plough up uncultivated land for padi; in all 48 acres were ploughed and this undoubtedly encouraged the padi cultivators as nearly 240 acres in this area were planted this season as opposed to 20 acres last season. Mechanisation of agriculture in this area appears to have a good chance of success, and the project was therefore handed over to the Rural and Industrial Development Authority who provided two tractors at the beginning of May when the departmental tractors were withdrawn for pioneering work elsewhere. Again, in Perak, the State Department has a mechanical investigation team which recently started work on the eastern side of the Perak River, in the sub-district of Parit. The importance of this work is shown by the fact that there are now some 30 tractors engaged in smallholding agriculture in Perak and controlled either by the Rural and Industrial Development Authority or such authorities as Village Committees and Resettlement Officers.

Rubber.

Replanting and New Planting.

During the quarter, 308,000 rubber stumps and 6,400 yards of budwood were supplied to smallholders for replanting and new planting. It is, however, considered that many smallholders are awaiting the provision of funds to be obtained through the cess on export of rubber provided in the Rubber Replanting Ordinance before commencing to replant.

In co-operation with the Smallholders' Advisory Service of the Rubber Research Institute, trials with hedge planting have been conducted

on smallholders land in many areas; some of the most interesting of these trials are in Malacca and Johore. In general it would appear that the hedge planting system and variations of it have good prospects of success at the hands of smallholders.

New Villages.

In most States and Settlements a considerable amount of time was spent during the quarter in soil surveying so as to provide good land close to the new villages for agricultural development. In many areas larger numbers of pigs are now being reared, and the extra manure has resulted in an increase in the quantity and quality of the vegetables grown near by. In many of the areas, shade trees have been provided and there is a heavy demand for fruit trees of improved quality, which the Department cannot at present provide. There is also a demand for imported types of poultry, which can be met only very slowly. During the quarter, 1,700 budded fruit trees, 64 Middle White pigs, 627 birds and 2,700 eggs for hatching were sold by the Department, and the majority of them found their way into new villages.

General.

With fewer Agricultural Officers in the field than at any time since the war, progress has necessarily been slow. The Department is, however, maintaining the important experiments and pilot schemes being conducted by the Field Branch, and the success of its efforts may be judged by the examples given in the preceding paragraphs. Advances in agricultural extension work can, however, only be made with the complete co-operation not only of the smallholders themselves, but also of other Departments. The Field Staff of the Department of Agriculture works very closely not only with the Drainage and Irrigation Department, the Rubber Research Institute and the Rural and Industrial Development Authority, but also with the many District and Resettlement Officers throughout the Federation.

Departmental Notes.

Promotions.

The Right Honourable the Secretary of State for the Colonies has approved the promotion of Mr. R. G. Heath, Chief Field Officer, to be Deputy Director of Agriculture, Federation of Malaya, with effect from the 29th February, 1952.

Appointments.

The Right Honourable the Secretary of State for the Colonies has appointed Mr. I. Watson as a Statistician in the Department of Agriculture, with effect from the 3rd April, 1952. Mr. Watson arrived in Malaya on the 26th April, 1952, and is stationed at Headquarters.

Mr. R. G. Heath, Deputy Director of Agriculture, has been appointed to act as Director of Agriculture, with effect from the 20th May, 1952.

Mr. A. L. Barcroft, Agricultural Officer, has been appointed to act as State Agricultural Officer, Perak, with effect from the 13th May, 1952.

Mr. J. Chattaway, Agricultural Officer, has been appointed to officiate as Settlement Agricultural Officer, Malacca, with effect from the 5th May, 1952.

Leave.

Mr. O. J. Voelcker, C.B.E., Director of Agriculture, Federation of Malaya, proceeded on leave on the 23rd May, 1952.

Mr. R. G. H. Wilshaw, Chief Research Officer, proceeded on leave on the 13th May, 1952.

Mr. H. J. Simpson, Senior Agricultural Officer, proceeded on leave on the 13th May, 1952.

Mr. E. A. Rosenquist, Botanist, proceeded on leave on the 16th May, 1952.

MARKET PRICES

April to June, 1952.

Rubber.—The second quarter of 1952 produced a drop of 21 cents per lb. in the Singapore average price of No. 1 R.S.S., f.o.b., in bales. The price was fairly steady in April, being 110 cents on the 1st, rising to 111½ by the 22nd, and dropping to 108½ on the last day of the month. The average price in April was 109.58 cents per lb.

May began with the price at 107½ cents; it was 104⅜ on the 5th and 95¼ on the 6th of the month. The price continued to drop until it was 77 cents on the 26th May but recovered a little to be at 83¾ on the 31st, giving an average price in May of 88.34 cents per lb.

The price fell again in early June but had returned to 85 cents by the 6th of the month. After a drop of ½ cent, the price slowly increased to be 96¾ cents on the 28th June, 1952. The average price in June was 88.74 cents per lb.

The average prices paid for smallholders' rubber at three centres in the Federation of Malaya during the second quarter of 1952 are given in Table I.

Table I.

Average Monthly Prices Paid by Local Dealers for Smallholders' Rubber, April to June, 1952.

(Dollars per picul of 133 1/3 lbs.)

Grades.	Taiping, Perak.			Seremban, Negri Sembilan.			Batu Pahat, Johore.		
	April	May	June	April	May	June	April	May	June
Smoked Sheet	120.75	98.20	97.00	117.50	98.37	91.00	121.00	—	—
Unsmoked Sheet	94.50	73.20	75.75	87.00	70.38	65.00	103.00	80.40	82.00
Scrap	43.50	38.80	41.00	38.00	30.85	32.69	30.00	20.40	26.50

This Table has been compiled from statistics supplied by the Registrar of Statistics, Federation of Malaya.

Tea.—Quotations for Malayan tea have not appeared in recent issues of the weekly report of the Colombo Brokers' Association. In the report dated the 24th June, 1952, the average prices of Ceylon teas were as follows, in rupees per lb.: High Grown Teas 1.90, Medium Grown Teas 1.60, and Low Grown Teas 1.49.

The retail price of Malayan tea (Boh) is $2.60 per lb.

Derris.—In April, the weekly reports of the Singapore Chamber of Commerce quoted this commodity at $150 per picul. For the first three weeks of May the price dropped to $135 but returned $150 in the last week, where it remained until quoted as $145 per picul on the 23rd and 30th June, 1952.

Tobacco.—The average prices paid per picul for cured leaf in Kelantan were:—1st quality $700, 2nd quality $480, and 3rd quality $185.

Rice.—The ration of rice has remained at 3½ katis per week. The range of retail prices, in cents per kati, of the three grades of rice are as follows:—High Grade 32 to 36, Medium Grade 25 to 28, and Low Grade 19 to 21.

An amendment to the grades and prices of rice was issued on the 1st July, 1952. The grades and retail prices, in cents per kati, from that date are:—Best Siamese Grade 38 to 40, High Grade 32 to 36, Medium Grade 26 to 32, and Low Grade 19 to 21.

Table II.

Singapore Prices of Various Agricultural Products.

(Dollars per picul)

Date	Copra, Sundried	Coconut oil*	Pepper, F.A.Q. Muntok white	Pepper, Gen. Muntok white	Gambier, Cube	Sago Flour, Lingga	Tapioca Flour No. 1	Oilcake, Round
1952								
7th April -	25.50	42.00	595.00	605.00	82.00	14.25	36.00	21.50
15th April -	24.00	41.00	560.00	565.00	79.00	14.00	35.00	21.50
21st April -	25.00	41.50	510.00	520.00	78.00	13.50	35.00	21.00
28th April -	25.00	41.50	490.00	500.00	78.00	13.00	34.50	20.00
5th May -	27.00	45.50	525.00	535.00	78.00	13.00	34.50	20.00
12th May -	29.00	49.00	580.00	585.00	77.00	13.00	34.00	19.50
19th May -	27.00	46.00	640.00	650.00	77.00	13.00	34.00	18.50
26th May -	25.00	44.00	535.00	545.00	75.00	13.75	34.00	19.00
3rd June -	24.75	42.50	545.00	555.00	75.00	14.00	35.00	19.00
9th June -	26.50	43.00	580.00	590.00	75.00	14.50	35.00	18.50
16th June -	26.50	44.50	530.00	540.00	72.00	15.00	35.50	18.00
23rd June -	25.75	45.00	550.00	560.00	72.00	15.50	35.50	17.50
30th June -	26.50	44.50	560.00	570.00	71.00	15.50	35.00	17.50

* F.O.B.

The above prices are taken from the weekly reports of the Singapore Chamber of Commerce.

FEDERATION OF MALAYA

PRODUCTION OF COPRA, COCONUT OIL AND COPRA CAKE.

(in tons)

Month	Copra Production						Coconut Oil Production		Copra Cake (Poonac) Manufactured	
	Estates		Smallholdings (estimated)		Total		Oil Mills		Oil Mills	
	1951	1952	1951	1952	1951	1952	1951	1952	1951	1952
January	2,346	2,740	8,501	9,296	10,847	12,036	5,537	6,681	3,532	4,244
February	2,516	2,777	6,323	8,510	8,839	11,287	4,856	6,338	3,072	4,016
March	3,059	2,864	9,078	8,522	12,137	11,386	5,752	5,616	3,784	3,647
April	2,888	2,964	7,832	8,684	10,720	11,648	5,714	6,128	3,585	3,949
May	3,200	3,279	10,764	8,560	13,964	11,839	6,718	5,797	4,342	3,820
June	3,692	3,643	9,518	7,642	13,210	11,285	7,287	6,067	4,716	3,960
July	4,083		11,580		15,663		8,571		5,567	
August	4,044		11,756		15,800		8,552		5,569	
September	3,777		10,551		14,328		7,833		5,043	
October	3,402		12,186		15,588		8,543		5,570	
November	3,245		10,392		13,637		8,491		5,456	
December	3,170		12,139		15,309		8,543		5,425	
Total	39,422	(18,267)	120,620	(51,214)	160,042	(69,481)	86,397	(36,627)	55,661	(23,636)

Notes:—1. The above statistics are compiled and published by the Registrar of Statistics, Federation of Malaya.

2. Estate copra production and coconut oil production are as declared by estates and oil mills respectively.

3. Statistics of smallholding coconut oil production are not available.

4. Smallholding copra production for commercial purposes is estimated from the formula: imports + estate stocks (opening) + estate production + smallholding production = exports + local oil mill consumption + estate stocks (closing).

FEDERATION OF MALAYA RUBBER PRODUCTION.

(In long tons, dry weight)

Month	Estates		Smallholdings (Estimated)		Total	
	1951	1952	1951	1952	1951	1952
January	29,482	27,044	26,588	23,770	56,070	50,814
February	26,519	24,007	22,468	19,200	48,987	43,207
March	30,591	25,679	28,000	20,810	58,591	46,489
April	24,470	25,533	22,005	19,065	46,475	44,598
May	24,227	27,362	20,124	18,346	44,351	45,708
June	28,141	27,243	24,498	20,333	52,639	47,576
July	27,286		21,097		48,383	
August	27,330		24,500		51,830	
September	26,293		20,733		47,026	
October	27,622		22,509		50,131	
November	26,690		20,502		47,192	
December	29,305		22,900		52,205	
Total	327,956	(156,868)	275,924	(121,524)	603,880	(278,392)
Total 1950	375,853		316,732		692,585	

This Table has been compiled from statistics published by the Registrar of Statistics, Federation of Malaya.

Smallholding production is estimated from purchases reported by dealers.

FEDERATION OF MALAYA
PRODUCTION OF PALM OIL AND KERNELS.

(In long tons as declared by Estates)

Month	Palm Oil		Palm Kernels	
	1951	1952	1951	1952
January	4,068	3,182	997	839
February	3,510	3,110	813	850
March	3,821	3,327	940	865
April	3,732	3,350	896	893
May	4,260	3,076	1,029	793
June	3,295	3,020	801	718
July	3,249		781	
August	3,913		946	
September	4,614		1,125	
October	4,854		1,172	
November	4,495		1,151	
December	4,463		1,120	
Total	48,274	(19,065)	11,771	(4,958)

In June, 44 estates (planted area 93,035 acres) were in production out of a total of 52 oil palm estates (planted area 97,503 acres).

MALAYAN AGRICULTURAL EXPORTS, JANUARY-MARCH, 1952.

Product	Net Exports in Tons.			
	Year 1950	Year 1951	Jan.-Mar., 1951	Jan.-Mar., 1952
Arecanuts	14,867	13,547	5,768	5,010
Coconuts, fresh †‡	36,917 †	32,540 †	8,765 †	16,186 †
Coconut oil ‡	56,045	68,139	11,351	13,222
Copra ‡	4,778	10,878 *	38	5,319 *
Copra cake	31,105 *	37,891 *	9,375 *	12,830 *
Gambier, all kinds	331	36	25	12
Palm Kernels	9,070	11,809	2,793	3,069
Palm Oil	50,638	45,022	13,758	12,343
Pineapples, canned	14,666	16,859	3,519	2,047
Rubber ¶	692,585 ¶	603,880 ¶	163,648 ¶	140,510 ¶
Sago,—flour	12,006	28,044	5,949	2,739
„ —pearl	1,665	3,401	777	1,646
„ —raw	15,693 *	27,603 *	7,462 *	6,568 *
Tapioca,—flake	1,098	462	304	22 *
„ —flour	2,782 *	4,475 *	1,572 *	1,077 *
„ —pearl	13,507	10,230	2,269	2,138
Derris	44	56	21	20 *
‡ Copra equivalent	96,589	100,499	18,642	16,491

¶ production (Federation of Malaya). † hundreds in number. * net imports.

METEOROLOGICAL SUMMARY, MALAYA, MAY, 1952.

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes									Number of days							
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F	Total		Most in a day Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more	Total	Daily Mean	Per cent.
										ins.	m m.	ins.						hr.	hr.	
Ipoh, Perak	92.3	73.9	83.1	95.2	72.0	86.2	76.0			13.04	331.2	2.76	19	18	9			204.30	6.59	
Port Swettenham, Selangor	89.5	74.5	82.0	92.6	72.4	85.2	77.0	85.5	85.6	8.66	220.0	3.26	16	13	2			167.80	5.41	
Kuala Lumpur, Selangor	89.9	74.1	82.0	93.9	69.8	82.1	76.4			15.36	390.1	3.06	21	19	12	7				
Sitiawan, Perak	90.2	74.0	82.1	93.0	72.4	85.6	75.4	86.4	86.9	2.78	70.6	0.60	18	12	2			199.05	6.42	
Kuala Lipis, Pahang	89.7	73.3	81.5	93.0	71.4	80.0	74.7	85.2	85.4	9.54	242.3	2.43	20	19	5	30		165.40	5.33	
Kuantan, Pahang	90.0	73.2	81.6		70.9		75.2			6.04	126.0	1.00	18	14	1	7		187.30	6.04	
Temerloh, Pahang																				
Bayan Lepas, Penang	88.5	75.9	82.2	91.8	73.4	84.2	78.4			9.43	239.5	3.01	21	20	1			188.30	6.07	
Malacca	87.0	74.9	80.9	90.2	73.0	83.5	76.9			4.68	118.9	0.83	18	15	1		3	217.10	7.00	
Mersing, Johore	88.9	73.2	81.1	91.5	72.1	80.9	75.8			6.00	152.4	3.55	14	9	3			228.45	7.37	
Alor Star, Kedah	89.0	75.0	82.0	93.0	73.3	82.6	77.2			12.85	326.4	3.82	18	15	1			186.15	6.00	
Kota Bharu, Kelantan	89.7	75.4	82.5	92.2	73.5	84.2	78.5	88.1		6.70	170.2	2.73	13	11	10			220.60	7.12	
K. Trengganu, Trengganu	89.2	74.0	81.6	92.1	71.2	83.0	77.0			2.92	74.2	1.16	11	10	4			214.50	6.92	
Kallang Aerodrome (S'pore)	88.5	76.9	82.7	91.2	74.4	84.8	79.4			4.35	110.5	1.45	14	11	4			196.55	6.34	
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft.	75.1	63.1	69.1	79.1	61.9	72.5	64.2	72.9	73.1	6.97	177.0	1.11	20	19		3		152.80	4.93	
Cameron Highlands, Tanah Rata, Pahang 4750 ft.	74.2	58.0	66.1	78.0	55.2	70.6	62.4	69.4	69.9	13.59	345.2	1.67	24	22	4	1		130.30	4.20	

Compiled from Returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, JUNE, 1952.

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes									Number of days							
	A. Max.	B Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F	Total		Most in a day Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more	Total	Daily Mean	Per cent.
										ins.	mm.	ins.						hrs.	hrs.	
Ipoh, Perak	92.5	72.8	82.7	94.6	69.9	89.4	75.8			2.73	69.3	0.98	6	6				223.55	7.45	
Port Swettenham, Selangor	89.4	73.1	81.3	91.7	71.2	84.3	74.8	85.1	85.7	7.24	183.9	2.31	13	10	1			212.90	7.10	
Kuala Lumpur, Selangor	89.9	73.3	81.6	92.6	70.5	84.3	75.6			6.34	161.0	1.43	16	15	5	3				
Sitiawan, Perak	91.6	73.1	82.3	94.3	70.4	88.8	75.2	86.2	86.9	3.36	85.3	1.20	6	6	1			227.00	7.57	
Kuala Lipis, Pahang	90.3	73.0	81.7	93.3	71.0	86.8	75.8	85.4	85.6	3.03	77.0	1.62	9	14	2	25		182.20	6.07	
Kuantan, Pahang	90.1	73.3	81.6	93.4	70.6	83.9	76.3			3.71	94.2	1.43	9	7		1		177.75	5.93	
Temerloh, Pahang																				
Bayan Lepas, Penang	88.5	75.0	81.9	91.0	72.0	84.0	78.0			8.39	213.1	3.68	10	7	1		2	210.75	7.03	
Malacca	86.0	73.6	79.8	88.3	69.1	82.1	76.8			12.49	317.2	3.34	16	13	5		7	186.85	6.23	
Mersing, Johore	88.0	72.6	80.3	92.6	68.8	79.6	75.5			8.92	226.6	2.94	15	14	5		1	182.80	6.09	
Alor Star, Kedah	89.1	74.4	81.7	91.3	71.6	84.5	78.1			5.94	150.9	2.31	15	15	2		1	170.25	5.67	
Kota Bharu, Kelantan	88.8	74.2	81.5	91.6	70.8	84.8	77.1	86.1		9.65	245.1	3.13	16	14	10	1	2	165.45	5.51	
K. Trengganu, Trengganu	88.2	73.2	80.7	91.5	70.6	84.5	76.0			6.90	175.3	1.74	14	11	7		1	185.20	6.17	
Kallang Aerodrome (S'pore)	87.7	76.7	82.2	91.1	69.4	82.4	81.2			5.20	132.1	1.26	12	11	2		2	186.55	6.22	
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft.	74.9	62.7	68.8	77.4	59.5	71.3	64.6	72.5	72.8	3.60	91.4	0.94	8	8	1	6		170.35	5.68	
Cameron Highlands, Tanah Rata, Pahang 4750 ft.																				

Compiled from Returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, JULY, 1952.

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes									Number of days							
	A. Max.	B Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F	Total		Most in a day Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more	Total	Daily Mean	Per cent.
										ins.	mm.	ins.						hrs.	hrs.	
Ipoh, Perak	91.0	72.1	81.5	94.2	67.6	85.4	76.4			5.05	128.3	2.76	9	9	2	2		194.50	6.27	
Port Swettenham, Selangor	88.8	72.6	80.7	91.5	90.0	85.3	74.3	84.7	85.4	1.50	38.1	0.54	8	7				189.15	6.10	
Kuala Lumpur, Selangor	89.2	72.6	80.9	92.8	69.4	83.6	75.0			3.15	80.0	0.87	11	9	2					
Sitiawan, Perak	89.5	72.3	80.9	92.4	68.2	82.8	75.2	85.1	86.6	1.96	49.8	1.52	6	6		1		207.70	6.70	
Kuala Lipis, Pahang	89.3	71.2	80.3	94.0	68.0	85.0	75.2	83.9	85.0	9.94	252.5	3.14	14	14	6	28		172.85	5.57	
Kuantan, Pahang	89.1	71.8	80.5	92.8	67.8	81.4	75.7			6.02	152.9	1.33	15	10	1	3		209.75	6.77	
Temerloh, Pahang																				
Bayan Lepas, Penang	87.1	74.8	80.9	89.2	71.5	82.2	78.0			8.60	218.4	1.46	16	15	3		1	194.30	6.27	
Malacca	84.8	73.7	79.3	87.1	70.3	80.7	77.6			12.21	310.1	2.74	21	18	5		6	175.70	5.67	
Mersing, Johore	86.9	72.1	79.5	90.2	69.9	81.8	73.9			5.45	138.4	1.88	12	11	4		1	159.65	5.15	
Alor Star, Kedah	88.0	73.9	80.9	91.8	70.8	82.7	76.3			4.50	116.8	0.94	16	13	2			176.20	5.68	
Kota Bharu, Kelantan	88.9	73.9	81.4	91.5	71.7	85.8	76.2	86.2		3.69	93.7	1.04	16	14	8	1		236.80	7.64	
K. Trengganu, Trengganu	87.9	72.7	80.3	91.0	69.3	84.1	74.9			4.54	115.3	2.36	11	8	4	1	1	197.90	6.38	
Kallang Aerodrome (S'pore)	86.6	76.3	81.5	90.1	71.9	80.8	81.0			10.74	272.8	3.98	16	12	5			171.20	5.52	
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft.	74.0	62.0	68.0	77.5	58.7	66.7	64.7	72.8	73.3	2.46	62.5	1.32	12	10	4	15		171.75	5.54	
Cameron Highlands, Tanah Rata, Pahang 4750 ft.																				

Compiled from Returns supplied by the Malayan Meteorological Service.